THE

ELECTRICAL REVIEW.

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THE

UNIVERSAL ELECTRICAL DIRECTORY

(J. A. BERLY'S).

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STORAGE BATTERIES.

FROM time to time we are treated to fair promises of obtaining a storage battery of at least one-third the weight of existing ones for the same output. These promises are even backed up by the signed reports of eminent experts, but the long-looked for battery, with all its virtues, never comes into the market.

One expert states that a certain cell under normal conditions gave out *about* 14 watt-hours per pound weight of battery cell, but the makers, with rare modesty, claim only 8 watt-hours, and users of the battery say they get only 5 watt-hours.

Another battery maker states that he can get 40 ampere-hours per kilogramme of plates. A well-known professional firm of testing repute is said to have obtained 33·3 ampere-hours from a cell weighing 8·2 lbs., equal to $\frac{33{\cdot}3}{8{\cdot}2} = 4$ ampere-hours per pound of battery. The 40 ampere-hours per kilogramme does not agree with the expert report of 33·3 ampere-hours from 8·2 lbs., and 4 ampere-hours is not an astounding result per pound of battery.

A favourite method of demonstrating the superiority of one cell over another is to take, say, a 3-plate cell of a well-known standard make, and compare its output per pound of plate or per pound of battery with a 5 or 7-plate cell—plates of same weight and size—of a new manufacture; by this little exercise of ingenuity immense improvement can be shown.

This is how it works out. Take a 3-plate cell, each plate weighing 2 lbs.; total weight 6 lbs. of plates, output 20 ampere-hours. Now take a 5-plate cell total weight 10 lbs.; we have not doubled the weight, *but we have doubled the output*, for we have two positives in place of one; so a 5-plate 10-lb. cell gives 40 ampere-hours, whereas a 3-plate 6-lb. cell gives only 20 ampere-hours; but the elastic conscience of the expert or maker does not put it that way. They merely give the ampere-hours per pound of battery or plates, without the slightest reference to the fact that the one cell is made for twice the discharge rate of the other cell.

$\frac{20}{6} = 3{\cdot}33$ ampere-hours per pound of plate for cell No. 1.

$\frac{40}{10} = 4$ ampere-hours per pound of plate for cell No. 2,

showing a very considerable improvement in cell No. 2, while in point of fact there is no improvement whatever, the plates in cells 1 and 2 being identical. This interesting experiment can be made with any cells, and goes a long way to account for the incomprehensible differences in expert reports.

The important question is, how are batteries to be fairly tested, and how are the figures obtained to be used to represent the truth? The fact that well-known testing experts

give faulty reports through a wrong interpretation of figures obtained is notorious, and unfair comparisons are made between cells of different discharge rates. Considering the remarks made by several speakers on Mr. Epstein's paper, it is a wonder the subject of testing and reporting on batteries was not more fully discussed. Mr. Holroyd Smith's remarks were quite to the point, and the quoted examples of impossible claims put forward for some batteries are worthy of careful study.

There is no mystery about the electrical energy equivalent for a pound of lead, for a pound of lead peroxide, for a pound of zinc, or for any other element; yet some of the claims made for batteries would ask us to believe that their inventors had endowed the elements with double their natural amount of potential energy, and thus they pose not only as inventors but also as creators of energy.

It may be objected that all the fallacies about batteries are well-known, and do not delude electrical engineers. Quite so; but many other people besides electrical engineers are interested in storage batteries, and it is chiefly for their benefit that these misleading reports are prepared and circulated.

We have looked over many reports and claims made for all kinds of batteries, we have tested cells of various types, and, taking all things fairly into account, the best results obtainable from lead accumulators in every-day work as apart from laboratory tests is 7—or, perhaps, 8—watt-hours per pound of battery, and that only if a fairly large size of cell is used.

Accumulators using cadmium and zinc have been patented and tried over and over again, with one result—failure. They show a reduction in weight per pound of battery, and we have tested a battery of this type, but they all fail through the exhaustion of the metallic solutions. The chief difference between these metallic solution batteries, as we may properly call them, and the non-metallic solution batteries is this. In charging an ordinary battery of lead in dilute sulphuric acid, the solution becomes stronger as the charge increases, but on charging a zinc or cadmium solution cell, the solution, on the contrary, becomes weaker and weaker, until at a certain strength the energy is wasted in freeing hydrogen gas only. Great things are claimed for a battery of this type, but we await a clear copy of the tests upon which the claims are based; we prefer to have the figures, and from them to draw our own conclusions. Without all the figures obtained during the tests it is impossible for us to accept the conclusions of any reports.

The interest in motor cars at present has brought to light many proposals for light motor car batteries, and the way in which some of these batteries are written up, and impossible claims made for them without any strictly accurate scientific proofs, renders it necessary to speak out plainly on the subject of storage battery testing and reporting thereon.

There is in last week's Electrical Review an interesting curve drawn by Mr. Rankin Kennedy, which may be advantageously studied and taken as a warning against the careless comparison of cells differing in size.

We would not discourage the electro-chemical worker or inventor upon whom, no doubt, the future of accumulator traction is dependent. But the sanguine and too often ill-founded conclusions and anticipations of the latter require to be kept in check; and for the commercial man who would promulgate them for his own interest, without due caution and skilled advice, we have neither sympathy nor toleration.

Secondary Batteries and the Institution of Electrical Engineers.

A valued correspondent—and he is not alone in his opinions—has pointed out to us that at least some of the members think that the time of the Institution has been practically wasted by reason of the audiences at the last two ordinary meetings having to listen to speakers who brought forward as valuable novelties crude notions which were long ago shown to be fallacies and blunders. As an instance, the allusion to the use of India-rubber in accumulators as a novelty is cited. Faure patented this in 1880, but it has been found quite inapplicable for the purpose, while it is contended that the problem has been solved by the use of indestructible inorganic materials. Some information on this subject was given in our columns some time ago (Electrical Review, p. 161, of August 9th, 1895). Our readers will be interested to learn that a well-known electrician, whose work on secondary batteries has hardly yet been properly appreciated, has achieved practical success in obviating the destructive action on the peroxide support. When further details are published, we anticipate that increased attention will be given to this matter.

The Institution of Electrical Engineers.

The annual general meeting of the Institution was held at the Institution of Civil Engineers on Thursday evening last week to receive the annual report of the Council and to pass the balance-sheet. The meeting was devoted to business matters affecting the Institution; the most important, in our opinion, being the proposal that a pension should be granted the retiring secretary, genial Mr. F. H. Webb. It is not often that one sees such a pleasant picture as was presented on Thursday evening; speaker after speaker rose to compliment Mr. Webb, and to express the indebtedness felt by all those connected with the Institution for his services during the past twenty years. Needless to say, the motion was carried unanimously, and Mr. Webb, who rose to reply, was greatly affected, and the few words in which he acknowledged the resolution were well-chosen and dignified. We join in wishing him many happy years of merited leisure, and are sure that in his position of honorary secretary he will still do good service to the body he has so faithfully served. The points of interest raised in debate upon the report and balance-sheet were comparatively few. Mr. Raworth was evidently contented with the form in which the financial status of the Institution was depicted, and no one seemed to have any fault to find with the Council's management during the past year. The president, Sir Henry Mance, announced that the premiums would in future be increased both in number and amount, and their importance would, therefore, attract more attention. Mr. Bright suggested that papers should be taken as read, and the discussion proceeded with after the writer had submitted an abstract to the meeting. Mr. Wordingham did not think that this course would, in the case of the Institution and having regard to the class and length of papers taken, prove satisfactory, and the general opinion of the members was apparently with him. The meeting passed off more quietly than has been its wont; everyone agreed that it was best to set aside one evening in the year for business, and not allow those devoted to the hearing and discussing technical papers to be broken into. The discussion on Mr. Epstein's paper will be continued at an extra general meeting to be held at the rooms of the Chemical Society, Burlington House on Friday, December 17th (to-day) at the usual hour.

THE DISTRIBUTION OF ELECTRICAL ENERGY IN PARIS.

The electric lighting companies have been established in Paris since 1888, and possess grants for their canalisations up to 1906. They met recently, and decided to ask the Municipal Council to prolong the duration of the concession. M. Charles Bos, municipal councillor, has just presented an interesting report on the subject. This report contains 24 chapters, of which we will give the titles and the contents:—

1. *A Brief Summary of Electrical Energy and Various Units.* 2. *Production of the Electric Light.*—In the first two chapters M. Charles Bos places before his colleagues various concise facts relating to electrical energy, the various units concerned, and the production of electrical energy.

3. *Alternating, Continuous and Polyphase Currents.*—M. Charles Bos compares continuous, alternating and polyphase currents, points out their respective advantages and disadvantages, and gives a table of the nature of the currents employed in the distributions. In Paris, out of seven systems of distribution, four are worked by continuous currents, two by alternating currents, and one by continuous and alternating currents (the testing station of the Halles). Out of a total power of 23,300 kilowatts in October, 1896, 17,750 kilowatts (76·2 per cent.) were furnished by continuous currents, and 5,550 kilowatts (23·8 per cent.) by alternating currents.

In France, out of 364 central stations in existence on January 1st, 1897, 275 used continuous currents, 74 alternating currents, three triphased currents, 11 continuous and alternating currents, one continuous and triphased currents.

In England, on May 1st, 1897, there were 119 central stations, 53 of which used continuous currents, 59 alternating currents, and seven alternating and continuous currents.

In Germany, out of 265 central stations, 204 were found to be using continuous currents, 26 simple alternating currents, 16 polyphased currents, and 19 mixed systems. M. Charles Bos shows in this chapter that alternating currents are suited to the transmission of electrical energy to a distance, with stations outside Paris and sub-stations in Paris for their transformation into continuous current. This last arrangement is necessary for the distribution properly so-called.

4. *History of Electric Lighting in Paris.*—This chapter gives the successive dates of the development of electric lighting in Paris.

5. *Various Lighting Systems.—Public Lighting in Paris.*—The number of arc lamps installed in Paris amounts now to 12,000, 7,800 of which are fed by the various sectors, and 4,000 are included in municipal installations, railway stations, shops, theatres, &c.

The incandescence lamps amounted to 702,900, 416,000 belonging to the sectors, and 286,900 to private installations.

M. Charles Bos next discusses the selling price of current for electric lighting by incandescence, and finds for one lamp-hour of 10 candles a charge of ·03 fr. at the rate of ·10 fr. per hectowatt-hour, the lamp consuming 3 watts per candle. We know that with the Auer burner of 4 to 5 carcels the price of the carcel-hour is about ·006 fr.; but this question involves a series of considerations upon which we cannot enter now. As regards public electric lighting in Paris, M. Charles Bos states that 744 arc lamps of 10 amperes on an average are established in various public roads, parks and gardens. The price per hour of a lamp of 10 amperes is ·40 fr. This price includes all the expenses of first establishment (except the supplying and fixing of the lamp-posts, the cost of which falls upon the city), maintenance and canalisation, and of the necessary apparatus and current.

The price of ·40 fr. is high. Estimating a lamp of 10 amperes to work at 52·5 volts as a mean between 50 and 55, the consumption is 525 watt-hours.

The price of the hectowatt-hour is therefore ·076 fr. As the cost price does not exceed 4 to 5 centimes, the companies can lower the price, which would enable the public lighting to be considerably developed.

6. *The Paris Sectors.* 7. *The Municipal Installations and Stations. Private Systems.*—This chapter gives information concerning the various sectors of Paris, and reproduces the synoptical table of *L'Industrie Electrique* for October 25th, 1896. The total power of the stations is 17,775 kilowatts.

M. Bos then passes on to the municipal stations, the total power of which he finds to be 1,610 kilowatts. In the private installations, theatres, railway stations, shops, hotels, there is a total power of 16,000 kilowatts. The total power used in Paris for electric lighting amounts therefore to 35,385 kilowatts.

In Chapter 9, M. Bos gives the history of electric lighting in France, and shows that the provinces are ahead of Paris, and that great efforts have had to be made to make up for lost time. Quite small towns were the first to be lighted by electricity. These enterprises have been carried out without very great expense. The municipalities interested were not hampered by any lighting monopoly previously granted to any company. It was a very different matter with large towns.

10. Electric lighting has been used at Havre since 1889; the central station sells current for lighting and motive power to consumers at the rate of ·08 fr. the hectowatt-hour, with reductions according to the importance of the consumption, and for tramways at the rate of ·0175 fr. the hectowatt-hour.

11. The electric lighting at Brussels is provided for by the municipality. The total length of streets laid with mains at the date of December 31st, 1896, was 33·4 kilometres, as against 24 in 1895. The total length of cables laid (feeders and distribution systems) was 194 kilometres. The feeders, 24 in number, having a total length of 18 kilometres, fed 45,600 16-candle-lamps.

On December 31st, 1896, the expenses of first establishment amounted to 4,923,584·66 fr.

The total working expenses in 1896, including wages, materials, maintenance, work done, &c., amounted to 190,516·75 fr.

The total receipts for the same season, including the supply of electrical energy, the hire of meters, the hire of installations, annuities paid on indoor installations, and different work done, were 388,501·16 fr.

The net profits were therefore 197,984·40 fr. The interest and sinking fund were thus covered at the rate of 4·02 fr. per cent. of the capital used for first establishment up to December 31st, 1896.

The consumers used 5,686,023 hectowatt-hours, and paid 353,795·88 fr. The selling price of the hectowatt-hour was therefore ·062 fr. The lighting of the communal buildings was paid for at the rate of ·056 fr. the hectowatt-hour. The number of lamps installed, reduced to 16-candle lamps, including the arcs used for the public lighting of the Grand Place and the Park, and the motors, nine in number, of 26·5 H.P., was 33,739. According to the general conditions of subscription, the selling price of electrical energy is ·07 fr. the hectowatt-hour. The selling price, of which we have spoken above, was only obtained subject to various reductions. The electrical energy for lamps in shop windows is paid for at the rate of ·05 fr. the hectowatt-hour, and the energy for motive power, heating, or other applications, is sold at the rate of ·04 fr. the hectowatt-hour.

12. *Electric Lighting at Berlin and in Germany.*—M. Charles Bos paid a visit to Herr Rathenau, the manager of the Allegemeine Elektricitäts Gesellschaft, that powerful company which has sunk in its various enterprises a capital of 340,000,000 fr. This company has formed another, the Berliner Elektricitäts Werke, which specially undertakes the electric lighting of Berlin. The central stations of Berlin had a total power of 10,868 kw., and fed 178,671 incandescence lamps, 7,131 arc lamps of 10 amperes, and 1,700 motors of about 6,449 H.P.

The electrical energy for lighting is sold at the rate of ·075 fr. the hectowatt-hour, with reductions of 5 to 50 per cent., according to the importance of the consumption.

For public lighting, after reductions, the cost price is ·03 fr. the hectowatt-hour. The electric motive power is supplied at the rate of ·02 fr. the hectowatt-hour. The tramways pay at the rate of ·0125 fr. the hectowatt-hour.

The Berlin Company has been in existence for 12 years, has a concession of 30 years, which terminates in 1917, and has already sunk more than half its capital. Coal costs 24 fr. a ton at Berlin; the cost of labour is as high as in Paris.

Amongst the dues, the town receives 10 per cent. of the gross receipts, and 25 per cent. of the net receipts, when the

latter exceed 6 per cent. of the capital. M. Raffalovich, in an article which appeared in *L'Économiste Français*, says that the company ought to establish a reserve fund by an annual deduction of 2 per cent. of the capital to the amount of 20 per cent. of the capital, and that this fund should take the form of bonds on the town. The net profits of the company, which were 319,000 marks in 1887-88, rose to 1,591,000 marks in 1894-95. The dividend for these years varied from 7·5 to 12·5 per cent., falling in 1889-90 and 1891-92. The share of the town in 1885 was 2,614 marks, and in 1894-95, 602,441 marks.

We see that if the Berlin Company has obtained, not a concession, but a grant of 30 years, the dues demanded are higher than in Paris, and yet the selling prices are from 30 to 40 per cent. less.

Another new company has just been formed by the Allgemeine Elektricitäts Gesellschaft for supplying the suburbs of Berlin.

This company, formed under the name of the Electrical Energy Company, of the Upper Spree, will supply electrical energy at the rate of ·0625 fr., the hectowatt-hour for lighting with deductions of from 5 to 50 per cent., and of ·0025 fr. on an average per hectowatt-hour for motive power.

13. *A Little About Electric Lighting Everywhere.*—In this chapter M. Charles Bos gives a list of all the selling prices of electrical energy that he has been able to procure in France and abroad, and it is a long one.

In Paris, the selling prices per hectowatt-hour vary for lighting from ·0962 fr. (the Left Bank Sector) to ·1269 fr. (the sector of the Champs Elysées), and for motive power from ·04 (the Left Bank Sector, the Lighting and Power Company, and the Edison Company) to ·06 fr. (the Halles and Clichy Sectors). In the provinces the mean selling price is ·10 fr.; we find, however, maxima of ·15 fr. and ·14 fr. at Grenoble and at Citat, and minima of ·07 fr. at St. Brieuc.

In London the mean price of the hectowatt-hour for lighting is ·063 fr., and for motive power ·04 fr., with varying deductions. In the provinces the mean price is ·06 fr. for lighting, and ·03 fr. for motive power. There are, however, widely differing maxima and minima for motive power (·0525 fr. and ·0105 fr.). We have already given the principal prices in Germany.

The maximum never exceeds ·098 fr., with considerable deductions. For motive power, especially, the prices are very low. They do not exceed ·0308 fr., and they often fall to ·027 fr.

In many other towns in Austria, Hungary, Norway, Belgium, Switzerland and Italy we find prices varying up to the high maximum of ·11 fr. the hectowatt-hour.

14. *Electricity Employed as Motive Power in France and Abroad.*—M. Charles Bos here deplores the fact that electrical motive power should be used less in France than in other countries. He first discusses electric tramways, and then passes on to the consideration of small motors.

In Chapter 15, M. Bos speaks of electric automobilism. He thinks that the central stations ought to instal recharging sub-stations of accumulators along the public streets.

In Chapter 16 he discusses the proposals that have already been put forward on this subject by the firm of Mildé.

In Chapters 17 and 18 M. Bos refers to the applications of electricity for motive power, cookery, and heating, and discusses the part that electricity will play in the future.

He asks whether it will be expedient to grant prolongations of the concessions to the Paris companies, and glances at the possibility of establishing a municipal station.

21. *The Cost Price of Electrical Energy (for Lighting and Motive Power) in Paris, France, and Abroad.*—We find in this chapter a great deal of information as to the cost price.

In Paris the cost price of the hectowatt-hour varies from ·04 to ·05 fr., including all expenses; at Berlin, where the conditions are to all intents the same as in Paris, M. Rathenau estimates the cost price of the hectowatt-hour, including all expenses, at ·025 fr.

For other foreign towns M. Bos remarks that they often have monopolies, or at least concessions of 30 to 40 years.

In England the cost prices vary from ·05 to ·028 fr, the hectowatt-hour.

22. *The Present Scale of Charges.*—This chapter is devoted to an examination of the present scale of charges, which is well known to electricians.

With regard to the dues payable by the electrical companies to the city, we draw up the following table, which sums up the estimates for 1897.

	Due of 100 francs per km. in francs.	Due of 5 or 6 per cent. on the receipts in francs.	Totals in francs.
The Edison Company	4,000	168,000	172,000
The Paris Electric Lighting and Power Company	5,500	94,500	99,500
Paris Compressed Air Company...	9,000	100,000	109,000
The Sector of the Place Clichy Electric Lighting Company ...	6,500	96,000	102,500
The Sector of the Champs Elysées Electric Lighting Company ...	6,200	70,000	76,200
The Left Bank Sector Electrical Company	4,000	50,000	54,000
			613,200

M. Charles Bos thinks the present scale of charges perfect. He only regrets that it is not applied. The municipal reserve of 1 metre along the fronts of houses is often reduced. No system of check is exercised.

The quinquennial revision of the selling prices has never been performed. M. Bos also considers that the canalisation is not sufficiently developed in the more outlying districts, and he asks whether it would not be possible to sanction overhead systems in order to facilitate the satisfactory extension of the more central systems.

He concludes the chapter with a severe criticism on the manner in which the work is carried out.

M. Bos concludes his report by saying that he is in favour of granting the prolongation of the concessions asked for, but on certain conditions.

The selling price of the hectowatt-hour shall not exceed ·10 fr. for lighting and ·03 for motive power.

ELECTRIC GAS ENGINE PLANT AT THE AMERICAN CIVIL ENGINEERS' NEW SOCIETY HOUSE.*

THE new house of the American Society of Civil Engineers, opened in New York last week, is provided with a complete isolated gas engine electric plant. This plant consists of two direct-connected units, the engines being of the double cylinder vertical type "Nash" gas engine, running at 280 revolutions per minute, and having each a capacity of 25 brake-horse-power.

The chief difficulty with, and objection to, direct-connected gas electric plants has been lack of steadiness in the lights due to explosive impulses of the engine. This objection has been entirely overcome in this plant, one element in the solution of the problem being the special clutch coupling employed, which automatically compensates for any residual fluctuations in the speed of the engine, with the result that there is none of the flickering of the lights that has been so common in gas driven plants heretofore. The regulation is equal to that of the best steam driven plants.

The building is wired for 500 lights and the generating plant is capable of operating the full number of lights when required. One unit, however, will take care of the load for all ordinary purposes. The feeders for both light and power circuits are brought to a switchboard of black enamelled slate conveniently located in the engine room. These engines operate upon a gas consumption of 17·5 cubic feet of gas per H.P. hour.

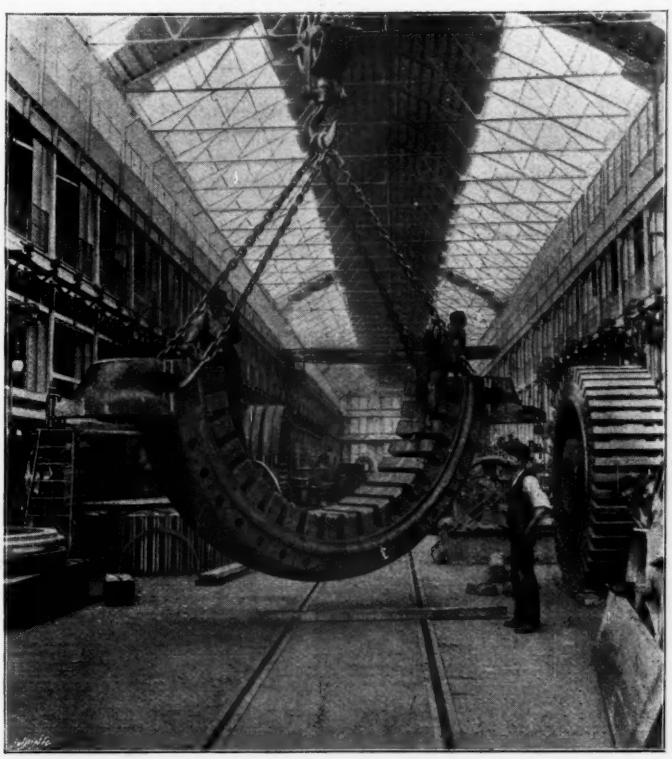
The entire generating plant, including engines, dynamos and switchboard, was installed by the Baylis Company, engineers and contractors, New York.

The type of Crocker-Wheeler dynamos employed are rated as 15 kilowatts at 125 volts, and run at a speed of 280 revolutions a minute. They give a free voltage of 115 volts, and are over-compounded 5 per cent. 125 volts are obtained by cutting out all of the field regulator. The dynamos have

* New York *Electrical Engineer*.

eight poles; the cores of the field-magnets being wrought-iron, round in shape and cast solid in the circular cast-iron yoke. This cast-iron yoke has an internal flange on each side, which partly covers the field coils, affording them considerable protection from mechanical injury, and at the same time allowing good ventilation. The poles are supplied with removable cast-iron shoes, clamped in place by a screw after the field coils have been slipped into position. These shoes reduce the density of the magnet flux in the air-gap, and permit thereby a long air-gap, which is of great value mechanically. The armatures are of large diameter and short length. The armature winding is done on forms previous to the application to the armature. Each coil is wound, then properly shaped so that it will nest with its neighbour, and then carefully insulated with a layer of oiled muslin and tape. When the winding has been put on the core, it is held down by clamps at each end, and the connections of the coils are made to the commutator tails, which are sufficiently long to keep cool and to hold the solder, even if the commutator should, by accident, become overheated. The coils are connected so that there are eight circuits in the armature. The windings of these machines are impervious to moisture and dust; and the manner in which they are applied to the core, permits such ample ventilation that severe overloads can be withstood without destruction of the insulation, although they may raise its temperature above normal. The armature core is mounted on a cast-iron spider which has an extended sleeve, upon which the commutator is mounted. The commutators are of large diameter and short length, and have a great many bars. The tails are riveted to the bars, and are made amply long to prevent overheating of solder by the bars.

The method of supporting the brush rods does away with the clumsy cable connections between brushes of the same polarity. Two carrying rings are used, which, while mechanically supporting the brush rods, connect them electrically, the rods being fastened to them. One of these rings holds all the positive, and the other all the negative studs. The rings are insulated from each other, but are mechanically one; and shifting of the brushes is obtained by moving them just as a purely mechanical holder would be moved. The rings, therefore, do away with the insulating of the brush rods and the connecting of alternate studs by cables. On account of the room saved by this arrangement, the carrying rings can be placed next to the armature, permitting the studs to point outward and over the commutator, which enables the brush holder to be withdrawn for cleaning or adjustment while the dynamo is running. The location of the carrying ring close to the frame not only leaves the commutator free and easy of access, but greatly enhances the pleasing appearance of the dynamo. The brushes are carbon, held in pivotal radial holders, and are of ample size to carry the current at low density per square inch of contact with the commutator.



Crane with Casting—Centre Westinghouse Aisle.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, PITTSBURG, PA.

By H. C. Gunton and H. Lomas.

Between two and three years ago, the Westinghouse Electric and Manufacturing Company owned and operated three separate plants, situated in Pittsburg, Pa., Allegheny, Pa., and Newark, N.J., respectively, and as at that time it became necessary to enlarge their capacity, the opportunity was taken to concentrate their factories in one location, and the present buildings and workshops were erected at East Pittsburg, on the Pennsylvania Railroad, about 12 miles east of Pittsburg.

Here are to be seen the latest improvements in the arrangement and operation of electric manufacturing machinery, and the work turned out represents the most modern practice in all the branches of electrical engineering. The land owned by the company includes about 40 acres, and, when the works are running full, over 3,000 hands are employed in the various shops.

We shall attempt a description of the general arrangement and equipment of the different departments, together with the apparatus in course of construction within their walls.

One photograph shows an exterior view of the works, taken from a point on the side of the valley opposite the embankment of the Pennsylvania Railroad.

Passing in at the right-hand corner and ascending to the second floor, the general offices are reached. Next to the general offices are the engineering offices, where the specialists get out their designs for work of a special nature, such as was required for the Niagara power scheme. This department is in direct communication with the drawing office, which is a spacious, well-lit room, capable of accommodating a large staff of draughtsmen. On one of the walls of the drawing office is a large blackboard ruled with 1-inch squares, and this is used for plotting out first sketches of machines of special design before getting out the regular working drawings.

From the drawing office we pass into the research laboratory, in which improvements in the details of switch and other apparatus are experimentally worked out.

The remainder of the second floor of this building, with the exception of a small testing shop, is taken up by the detail department, known as Section D, which deals with switchboard work, meters, instruments, &c., and here are manufactured the Schallenberger meters, of which about 100,000 per year are turned out.

A large building of three bays, to the left of the building just described, is the machine shop. It is 754 feet long × 231 feet wide. The centre bay is

open from the ground to the roof, and is served by three 30-ton overhead travelling cranes driven by direct current motors, while the side bays are served by smaller cranes of about 10-ton capacity.

A gallery runs right round the shop, forming a second storey to the side bays, and communication with the ground floor is by means of several elevators and staircases.

It will be easy to explain how the different classes of work are divided up into sections.

Section A. Western bay.—Street railway work, including motors and generators of under 100 H.P.

Section B. Centre bay.—Large work and erecting. At the far end of this bay are the testing beds.

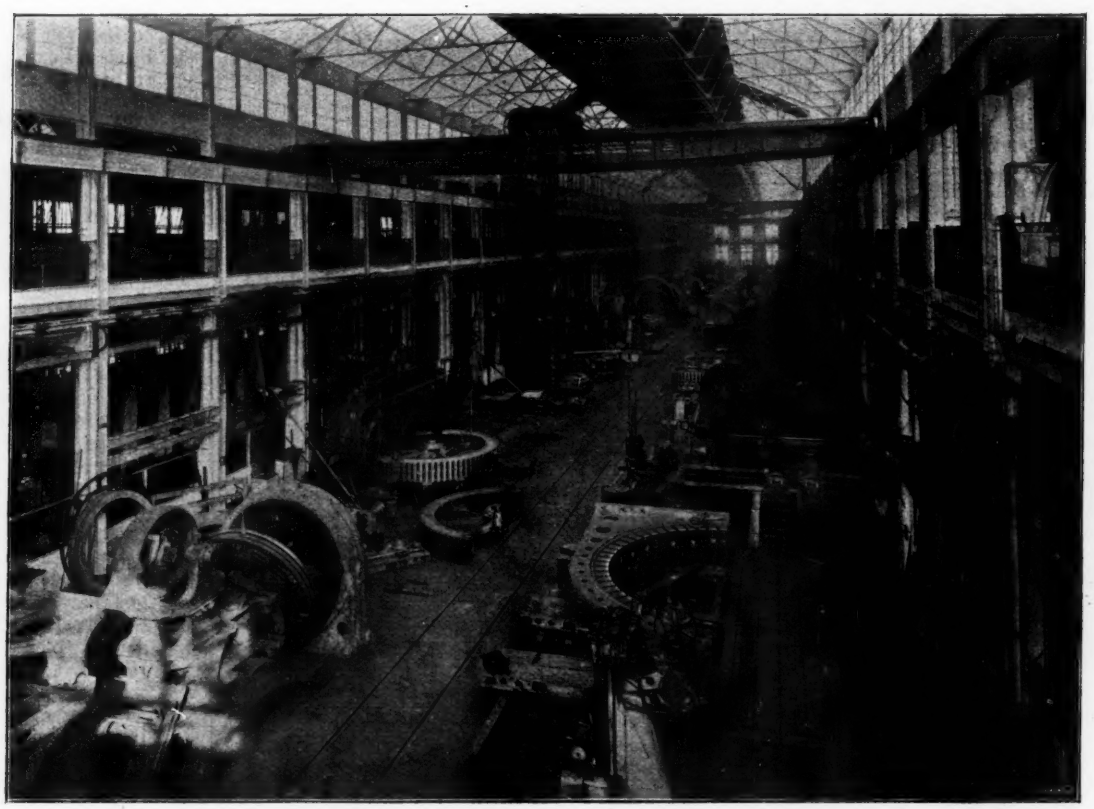
Section C. South bay.—General work.

Section E. South gallery. Transformer construction, and winding and insulating.

Section F. South gallery.—Commutators and screw machines.

The remaining buildings include the smithy and brass foundry, the punching shop, and the power house.

The construction of these buildings is carried out in steel and brick for the most part, the only wood used being for the flooring. They are very well lit, and are heated by hot air distributed through overhead ducts by 30-H.P. motor fans. The temperature is kept at about 60° in the coldest weather, and it is interesting to note that in the case of the machine shop, which includes a volume of 9,170,000 cubic feet of air, 20,000 square feet of heating surface was provided. The shops are also equipped with a complete fire extinguishing system.



Interior of Westinghouse Workshop.

Railway tracks connect and run through the different buildings, and are operated by the Westinghouse electromagnetic system. One of the most striking features in the works of the Westinghouse Company is the electrical distribution of power.

As a general rule, the shafting about the workshops is divided up into lengths, requiring from 10 to 50 H.P. The different lengths of shafting are driven by two-phase Tesla motors run off 200-volt mains. These motors have stator secondaries into which a resistance is inserted which is cut out when the motor has started up. The current for the rotor primary is gathered from collecting rings placed on the shaft outside the bearing. This method of driving the shafting has proved most satisfactory, and it is estimated that a considerable saving of power has been effected by the adoption of electrical power. The frequency adopted is 25 cycles per second, which, although too low for arc lighting, is perfectly satisfactory for incandescent lamps, which are largely used about the shops in conjunction with some arc lamps. The power house is in a central position, and is neatly and handsomely equipped. The generating machinery is divided into two sections. On one side of the engine room are three 500-H.P. Westinghouse engines, each of which drives direct a two-phase Westinghouse alternator, which generates current at 220 volts. On the other side are three engines of the same type and size, driving direct current generators, which supply current at 500 volts for the crane motors and other purposes.

In order to increase the economy and flexibility of the system a rotary converter is provided so that when necessary power can be transferred from the alternating to the direct current side, or *vice versa*, thus avoiding the necessity of running one of the sets when very much underloaded.

The current for the electromagnetic railway system is supplied by a generator which is direct-coupled to a two-phase motor, while the exciting current for the two-phase generators is obtained from a small machine driven in the same manner. The switchboard is provided with synchronising arrangements, the two-phase generators being usually run in parallel.

It will be well to give a short description of some of the work to be seen about the different departments.

In Section A the Westinghouse street railway motors were being built in large quantities. After erection these motors are tested in pairs as dynamo and motor alternately. For the insulation test nothing less than an alternating current test at about 10 times the ordinary voltage is relied on.

A fine piece of plant was being erected in Section B, namely, a 1,500 kw. railway generator for direct driving. The weight of this machine would be about 200,000 lbs.,

and the overall height about 18 feet. It gives 550 volts at 75 revolutions per minute. This type of machine has a cast-iron field-magnet ring into which are cast the laminated soft steel pole-pieces. The field casting is divided vertically, and means are provided for opening it out in a horizontal direction. A special feature in the construction of the laminated pole-pieces is the rounding off of alternate sheets in order to obtain a proper distribution of the magnetic field. The spaces left by the sheets which are cut away are filled in with plaster of Paris.

The shunt and series coils are placed separately on the pole and are easily removed. The armature is built up of punched steel discs carried on an iron spider and is wound with bars of drawn copper. The commutator is built up with hard rolled copper sections with mica insulation and the brush-holders, which are carried by brackets from a ring concentric with the field-magnet ring, are adjustable by means of a worm and hand wheel.

On the testing bed was a rotary converter which is designed to transform the Niagara current at 2,000 volts to direct current at 150 volts for electrolytic work. This machine had no magnet coils, the armature exciting its own field.

Section C.—The general work in this bay includes the two-phase Tesla motors, of which the Westinghouse Company build two types. The first type, which is used for driving purposes about the shops, has already been described.

The second type has, in contra-distinction to the first, a stator primary and a rotor secondary of the squirrel cage form, the conductors being bedded in slots in the core and short-circuited by a ring. These motors are self-starting under load without starting resistances, and sizes up to 400 H.P. are turned out.

Section E.—In this section the transformers are built up. The coils are wound separately, and are placed together side by side, being insulated from one another by flat plates. In the larger sizes the end coils are spread out so as to increase the cooling surface. Transformers for high-tension use are generally insulated and cooled by circulating oil, which rises in the centre of the coil and descends down the sides of the case, which is provided with ribs presenting a large surface to the air.

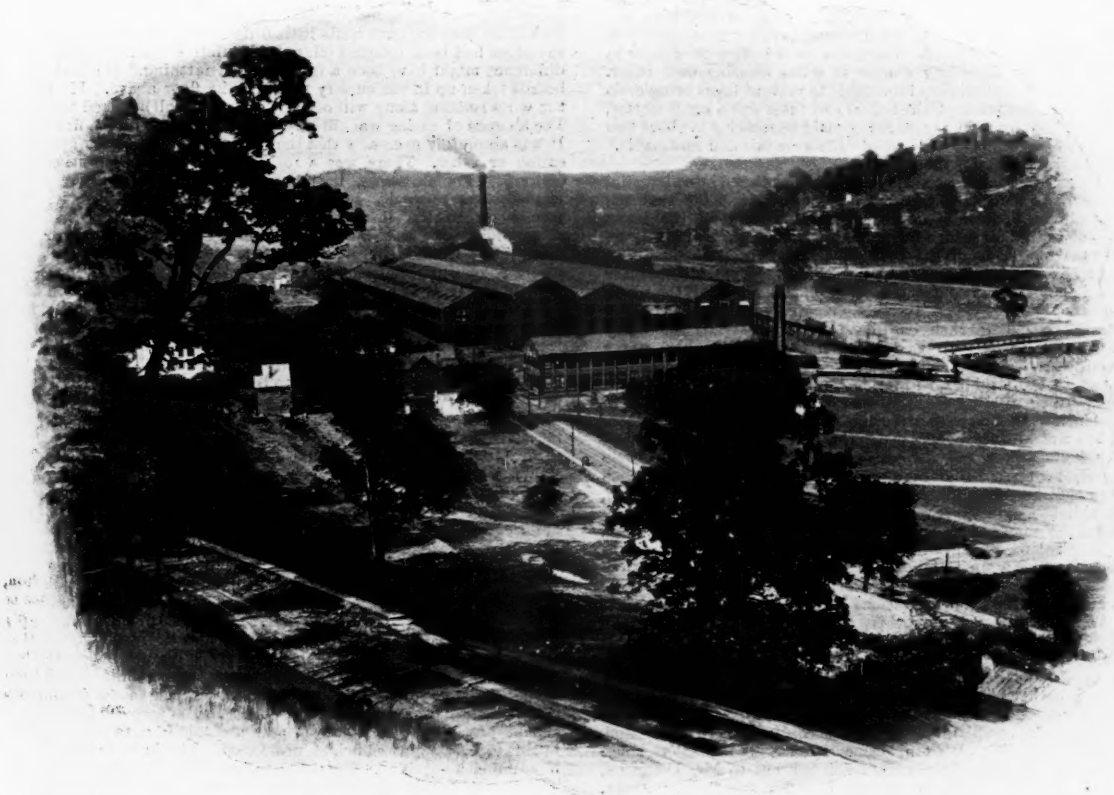
Section F.—This section contains the screwing machinery, and the commutators are built up here.

Section D.—Here a large switchboard for power purposes had just been put together. It was built up in white marble panels, those for the generator at one end, and those for the circuits at the other, with a wattmeter for measuring the total output in the centre.

The separate panels are provided with an angle-iron frame work, by means of which they are bolted together.

The whole framework is held by a channel-iron at the bottom, and by an iron bar at the top, and is provided with means for bracing it against the wall.

The writers are much indebted to the kindness of Mr. Warren, second vice-president, his assistant, and other members of the Westinghouse staff, for the kind way in which every facility was furnished them for seeing these gigantic workshops.



Exterior View of Westinghouse Works.

LEGAL.

Donnison, Berlyn & Co., *v.* Lord Charles Beresford.

(*Concluded from page* 830).

The further hearing of this case was resumed on Wednesday last week.

Mr. Lowry (recalled) was again cross-examined by Mr. Walton. He stated that in regard to the dry joints, he insulated them before leaving the defendant's house. That was to say, he covered them up with India-rubber, and it would not be apparent on sight that they were dry joints.

Re-examined by Mr. Reed: The plaintiffs' firm fixed 123 lamps altogether in the defendant's house.

Mr. George Edwards, assistant electrical wireman to the plaintiffs, gave evidence to the effect that the wiring of the defendant's house was carefully and properly done. He never saw any wires laid under the floors or inside the walls without being cased. No joints under the floor were left dry, but all were soldered.

Mr. Alfred Henry Walton, A.M.I.C.E., M.I.E.E, and acting engineer to the Metropolitan Electrical Supply Company, deposed that early in December of last year he went with Mr. Donnison to inspect the installation at the defendant's house, Messrs. Ellis and Ellis having in their letter to the plaintiffs stated that it was in a dangerous condition. He examined the installa

tion carefully, and saw nothing whatever that was dangerous. At the suggestion of Mr. de Segundo, who was present on behalf of the defendant, a piece of the flooring was taken up in one of the bedrooms on the third story, Mr. de Segundo remarking that it would be a fair test of how the work had been carried out. This was done, and the joints were found to be everything that could be desired. Mr. de Segundo then volunteered the information that he had taken up the flooring in another room, and had there found the work equally satisfactory. Witness saw nothing that would induce him to cut off the current. Bunching was no source of danger, but an every-day occurrence. He was pointed out one or two dry joints in the case of brackets, which he understood were temporary, and from which there could be no danger.

Cross-examined by Mr. Walton: He should not consider it good workmanship to leave dry joints, and then insulate them, so that it could not be discovered that they were dry joints.

Re-examined by Mr. Reed: He should think, from the account of Mr. Rorke, that from his charges that gentleman had re-wired the whole place on a different system.

Mr. Adrian Collins, A.M.I.C.E., and consulting electrical engineer, deposed that he had seen the plaintiffs' account and specification, and the defendant's counterclaim. The system adopted by the plaintiffs for the installation was both safe and sound, and some of the matters in the counterclaim were merely objections to the system which had been adopted. There was, in his opinion, no solid foundation for these complaints against the system. As to the dry joints, it was usual to leave them dry until the final position had been decided upon, so as to prevent danger by continual cutting of the wire and soldering. The position of a bracket, however, having been determined, the joints should be soldered. There was no objection or danger in bunching, nor was there any danger in wires crossing each other. In some cases it was absolutely impossible to prevent there being cross circuits. The numbering of the letters and fuses was a small matter, and if it had been omitted, the omission could be rectified in about two hours. The charges made by the plaintiffs were fair and reasonable.

This closed the case for the plaintiffs.

Mr. Walton, for the defence, said the plaintiffs entered into a bargain, for which they fixed their own price, the stipulation being that the work should be done in a first-class manner, with all the latest improvements, and all security against the danger of fire. All the articles used were to be of the best materials. Mr. Rorke had been engaged to fix certain fittings, and do other work outside that for which the plaintiffs had contracted. The plaintiffs had left the place, having stated that they had absolutely completed their work, when Mr. Rorke discovered that one or two brackets contained dry joints, which was a serious defect. The plaintiffs had never suggested to anybody that the joints were left dry, but had covered them up with India-rubber, so that it could not be seen they were dry jointed. From other observations he made, Mr. Rorke came to the conclusion that the distributing board would not bear more lamps, but was already overloaded. On pulling away a bracket or two, he found there was no casing for the wires. Seeing these symptoms, he formed the opinion that the work was of such a character that he ought not to touch it. He communicated with Mr. Macdonald, the private secretary of Lord Charles Beresford, and submitted the names of six engineers, any one of whom, he suggested, might be asked to examine and report upon the installation. Mr. Macdonald selected Mr. Gatehouse, who came to make his inspection. This gentleman saw the dry joints, which he regarded as inexcusable. He had also shown to him indications of defective casing, and one or two other matters. Upon this he advised that the whole installation should be overhauled, and in the meantime ordered the current to be cut off altogether. Mr. Macdonald then called in Mr. de Segundo, who did not know that Mr. Gatehouse had been employed. Mr. de Segundo thought it only fair that the plaintiffs should have an opportunity of seeing the defective work complained of, and accordingly Mr. Donnison, accompanied by Mr. Walton, came to the defendant's house in February. The dry joints were pointed out to Mr. Donnison, who had not one word of excuse to offer for them. Again, the specification provided that the wires should be cased in American wood and separated from one another; but on taking down the plaster of the walls it was found that the wires were not cased, but ran down the walls and under the floors without any protection. A great deal of the wire was in a dangerous condition. There were a dozen or 16 cases of dry jointing, some of which could not in any sense be said to be temporary, but were clearly intended to be permanent. Besides, the wires being uncased, there was serious bunching. Mr. de Segundo advised what was necessary to be done to put the installation in a satisfactory condition, and his recommendations were carried out. Other persons were thus employed to do the work which ought to have been done by the plaintiffs. The defects in the plaintiffs' work were of such a nature that they would have prevented any insurance office passing the house, and were breaches of the rules of such offices.

Mr. Richard Henry Macdonald, private secretary to Lord Charles Beresford, gave evidence as to Mr. Rorke making a certain communication to him as to the manner in which the plaintiffs' work had been carried out. In consequence of this, consulting engineers were called in, and their recommendations were carried out. Mr. Rorke did the work which one of the consulting engineers reported to be necessary.

Mr. T. Ernest Gatehouse, A.M.I.C.E., M.I.M.E., M.I.E.E., and editor of the Electrical Review, deposed that on February 15th he was invited to inspect the defendant's residence. The name of the firm who had done the work was withheld from him. He was told there were some defects which had been discovered—namely, that the distributing board was overloaded at several circuits, some bad joints found under the floors, and that the wires were running along without any protection whatever. He had the metal brackets removed from the walls in the study, the drawing-room, and a room leading off the latter. Seven or eight brackets were removed, and he then found that the joints between the sub-mains and flexibles were simply twisted together and left unsoldered, which was a dangerous condition of things. There was just a rubber tape put over them, but no braiding to protect them from any mechanical injury. The tape had to be unwrapped before it could be detected whether they were dry joints or not. A joint should be soldered, and its resistance should be such that it was no greater than any other part of the circuit of the same length. It was soldered to make it one continuous wire, and to render it mechanically and electrically perfect. When joints were left as these were the resistance became too great in course of time. Wherever there was a resistance to the passage of the electric current heat generates, and the heat at these joints sometimes became so great as to heat the metal to red or even white, and thus set fire to anything in the neighbourhood. He noticed that the flexible wires which were connected at the back of these brackets to the sub-mains were brought through holes drilled in the metal brackets, sharp edges were left, and no insulating collars put in the holes, as there should have been, and as was usual in first-class workmanship. By reason of there being no insulating collar, abrasion could take place between the sharp edge of the holes and the flexible wires. That was a practical danger, from which many fires occurred, through the ignition of the insulation of the flexibles. This was especially the case in America.

Mr. Justice Mathew: Is there no other way of preventing sharp points?—The edges could have been rounded off, but it is much better to put in an insulator. Metal is a conductor. It would (continued the witness) have made little difference in the expense whether the edges had been rounded off, or an insulating collar put in. The difference might have been a fraction of a farthing. He had some boards taken up in the nursery floor and the floor above. He found the wires running along without any casing, and all bunched together. The absence of casing was entirely against the rules of the fire office. It was absolutely necessary that the wires should be kept apart by casing or tubes. There was a real danger if that precaution was omitted. For instances, in the case of floors which had to be washed, water would go down between the cracks in the boards on to the insulating cover of the conductors, and the alternations of wet and dry were most damaging to the insulation. In the course of time the insulation would perish, or would so seriously deteriorate that there would be leakage. Even without water, it would perish in course of time. When perished it would become a source of danger, the wires being apt to come into contact with one another. In addition to that, there was danger from accidents. For example, a nail might be driven through the floor, and prick through the insulating material. Casing was a well-recognised precaution that ought to be adopted in every installation, though he was very much afraid it was frequently omitted. Casing or tubing was absolutely necessary to make an installation safe, and it was specially stipulated for in this contract.

Mr. Justice Mathew: Would that ensure absolute safety?—I would not say that; but, of course, it makes it very much safer than it would otherwise be. It was one of the elementary features of wiring that positive and negative conductors should be kept well apart everywhere, except in the case of flexibles, when they could not help themselves. The wires should be protected by casing or tubing wherever they went under floors or through walls. As a result of what he saw, he formed the opinion with regard to the installation, as a whole, that the house might catch fire in any one of a number of different points, and he requested Mr. Macdonald to have the supply of current cut off. He also recommended that the whole installation should be thoroughly overhauled by some competent contractor. The system adopted by the plaintiffs was right enough if it had been properly carried out. For every circuit carrying 4 to 5 amperes there should have been fuses on each pole. Ten amperes on a circuit should not have been allowed, and a single fuse, as was adopted in this case, was not sufficient protection. The fuses ought to have been more sub-divided. Extra fuses should have been put in to safeguard every circuit and were most necessary. The test adopted by the Metropolitan Electric Supply Company was absolutely useless to enable one to ascertain whether the joints were soldered or unsoldered. It simply showed that the insulating covering of the wire was good enough, but did not show the condition of the conducting wires themselves.

Mr. Segundo, A.M.I.C.E., A.M.I.M.E., A.I.E.E., consulting engineer, deposed to making an examination of the installation, and finding such defects as 16 or 18 joints which had not been soldered, single fuses, an absence of casing for the wires, and bunching. These defects were such as to cause a risk of fire. The witness gave evidence in detail in general agreement with that of Mr. Gatehouse, and produced photographs showing the actual condition of the work at the time he inspected it, and after it had been set right Mr. Rorke did the work that was necessary to remedy the defects that were discovered, and what he did was absolutely requisite for the safety of the house and the proper working of the electric lighting installation.

Lady Charles Beresford was called, and stated that Mr. Rorke was requested by her to do certain work which was quite apart from the plaintiffs' contract, such as putting in extra lights, and so on.

The Court adjourned.

The further hearing of this case was resumed on Thursday.

Mr. Segundo (recalled) was further examined by Mr. Walton. The witness produced a diagram showing the system, which was carried out under his direction, as to the distribution of the fuses. Instead of there being a single thick fuse from the pole of the distributing board, there were four thinner fuses which took the place of the one. Four was not the actual figure, but that was a diagrammatic representation of the sub-division of the fuses adopted. Instead of one fuse connecting several circuits, he sub-divided them

as far as possible so that each circuit should have its separate fuse.

In cross-examination by Mr. Reed, Witness stated that on the day of his inspection, when Mr. Donnison and Mr. Walton were present, the floor in Lady Charles Beresford's bedroom was taken up. There was a casing there, but it was not sufficient. He took up another part of the floor, and examined a joint, which he found all right. He could not recollect whether he said to Mr. Donnison that he had examined another joint previously, which he had also found satisfactory. He had examined another joint, but whether it was anterior or posterior to this, he could not say. Whether it was before or after, the joint was all right. He did not say anything to Mr. Donnison and Mr. Walton about having taken up the floors and found defective casing, except that which had been found in Lady Charles' bedroom. He told Mr. Walton, to the best of his belief, that he had been asked to put on additional lights, but found the fuse board already fully loaded. Mr. Rorke stated that he was of opinion that additional lights could not be put upon the board, and it was this which led to the whole investigation. He knew that the plaintiffs had only put up 110 lamps. He did not know that Mr. Rorke had fitted up a number which was largely in excess of this.

It was not contemplated that there would be these additional lights for this distributing board and there were no spare plates left?—Possibly not.

In reply to further questions, Mr. de Segundo said that Mr. Donnison stated, when particular things were shown to him, that they had not been done by his firm but were the work of somebody else. He did not himself know whether there was a good deal of added or altered work which had been done by Mr. Rorke, but he took the installation as it stood.

Was the work which you now say has been done, of running back an additional cable from the main and so making two distinct circuits, provided for in the specification?—No.

Did you ever suggest that the plaintiffs should be called in to set right the defects you discovered?—I do not think I ever made that suggestion. I cannot recollect, but I may have done so. I discussed the matter at length with Messrs. Ellis & Ellis, the defendant's solicitors, and suggested that Messrs. Donnison should be called in to see the work, and that nothing should be done before they had seen it. I said to Messrs. Ellis, that judging by the character of the work I had seen, it had been so carelessly done that I did not consider they ought to insist on calling in the same people to put things right if they could not do better work than that.

Mr. Justice Mathew asked Witness if at that time he knew the plaintiffs were the contractors, and Mr. de Segundo replied in the negative.

Do you tell the jury that you had no knowledge that the plaintiffs were the contractors?—Yes. He added that he believed he advised that they should not be called in to set right the defects in consequence of the manner in which the work had been done.

Mr. Reed: Did you not see the plaintiffs' name on the distributing board?—I did not notice it there.

In re-examination, Witness said he called Mr. Donnison's attention to all the defects which he had mentioned in his (Mr. de Segundo's) report in detail, and Mr. Donnison then said he was not responsible, and that evidently somebody else had been doing work there. In his opinion, sub-division of the fuses was necessary to make the work of the installation first class.

Mr. Rorke stated that he was a practical electrician of 14 years' experience, and had carried out the electric lighting installations in the Duke of Marlborough's house, the Carlton Club, and many other establishments. He had nothing to do with the work at Lord Charles Beresford's until December, when it was practically completed. He was then asked by Lady Charles Beresford to put in certain brackets, and altogether he fixed six before Mr. Gatehouse and Mr. de Segundo were called in. In January he was asked to put in certain additional lamps, and up to the date when Mr. Gatehouse was brought in he had not interfered with the wiring in any way. He had fixed one circuit with a dome light over the staircase and one from the side of Lord Charles Beresford's bed. He did not attach them to the other circuits, but brought them independently to the distributing board. At a later date he had occasion to remove a bracket for the purpose of copying it, and it was then found to be dry jointed behind. His foreman reported to him that on removing one of the distributing boards on the third floor, he had found it to be overloaded, so that he could not attach his wires to it. Witness inspected the board, and came to the same conclusion as his foreman. He mentioned the matter to Mr. Macdonald, who said that there might be more behind all this, and suggested that some consulting engineer should be called in to report upon the matter. He submitted six names to Mr. Macdonald, who selected Mr. Gatehouse. This gentleman was called in and made his report, without any consultation whatever with witness. Mr. Gatehouse discovered a number of dry joints, and none of these had been put in by witness. Subsequently Mr. de Segundo was also called in, and both consulting engineers recommended that the whole installation should be overhauled. Witness was present when Mr. Donnison and Mr. Walton came to see the work. On that occasion witness never admitted that one of the unsoldered joints behind the brackets had been put in by him, and as a matter of fact, none of the defective work had been done by him. He never touched the wires in any way until he commenced the work of putting the installation right. It was found that as the work had been left by the plaintiffs there was no casing for the wires, which were also crossed and bunched. Out of, say 100 joints, 95 were not soldered.

Mr. Justice Mathew: That is practically saying none were soldered?—Scarcely any were soldered at all.

Witness added that he did nothing whatever except what Mr. de Segundo told him to do, with a view to putting the installation right.

Cross-examined by Mr. Reed: One of his first jobs on December 19th was to fix brackets on some of the plaintiffs' wires. If the position of the brackets was going to be repeatedly altered, dry joints were always used.

Re-examined by Mr. Walton: He himself had only added nine or ten lamps to the installation, and to enable the distributing boards to carry these lights he had enlarged them. It ought not have been necessary to have enlarged the distributing boards, which should have left a margin for additional lights, but they were already overcrowded.

Mr. Alfred Edward Boxall, foreman to Mr. Rorke, was also examined, and this concluded the evidence.

At the conclusion of counsel's addresses and his Lordship's summing up, the jury returned a verdict in favour of the plaintiffs, the question of the amount to be determined by the parties after a consultation, the matter to be again mentioned if an agreement as to figures was not arrived at.

The Improved Electric Glow Lamp Company *v.* Edison-Swan Company.

In the Chancery Division on Friday last, before Mr. Justice North, Mr. Bousfield, Q.C., said he had to move in the action of the Improved Electric Glow Lamp Company *v.* The Edison Swan Company for an injunction to restrain the defendants, until trial or further order, from making certain glow lamps in infringement of the plaintiff's patent. The action had been standing over for some time, and it was hoped that an agreement would be arrived at between the parties, but such was not the case, and he was, therefore, instructed to bring the motion on.

Mr. Moulton, Q.C., said that without desiring to anticipate what his Lordship's decision would be on the motion, the order would probably be for an undertaking to keep an account until the trial. That undertaking he was quite willing to give. There was, no doubt, a serious question to be tried, but, in giving the undertaking, it must be understood that it was not to be made use of for the purposes of advertisements.

Mr. Bousfield thought he could accept the undertaking, and the case therefore stands over till the trial.

Tracey *v.* The London Electric Omnibus Company.

This case, heard by Judge Lumley Smith, Q.C., in the Westminster County Court on Monday, was an action, remitted from the High Court, by Mr. Paul Tracey, mechanical engineer, to recover £57 8s., for making and cleaning axles, bolts, and other metal work for the defendant company. £33 was admitted, and the balance claimed was £24 8s. Plaintiff deposed that the charges were fair and reasonable, and the work was done according to specification. The defence was that some of the charges were very excessive.

Mr. Brown, electrical and mechanical engineer, gave evidence as to the fairness of the charges, and plaintiffs' foreman formally proved the time-sheets, said tools had to be specially made for this job, and seven or eight men were employed on it worked 9½ hours per day at plaintiff's shop.

Mr. Ward, engineer and electrician to the company, said he calculated £33 was all plaintiff was entitled to. That was based on cost of metal, 33 per cent. shop charges, and 25 per cent. on the whole for profit. The labour charged was too much.

Mr. Mackie, electrical and mechanical engineer, said the charges were excessive. He gave £37 15s. as his estimate of what the charges should be altogether.

His Honour gave plaintiff judgment for 50 guineas, with costs, which included the £33 which was paid into Court.

Extension of Patent.

Before the Judicial Committee of the Privy Council (present: Lord Hobhouse, Lord Macnaghten, Lord Davey, and Sir Richard Couch), this petition by Mr. Illius Augustus Timmis, civil engineer, of 2, Great George Street, for an extension of the term of letters patent granted on December 12th, 1883, for 14 years to Mr. Stanley C. C. Currie and himself for an invention of improvements in the means for working and interlocking railway signals by electricity, was heard.

Mr. Bousfield, Q.C., and Mr. J. C. Graham, were counsel for the petitioner; the Attorney-General and Mr. Henry Sutton for the Crown.

The invention in respect of which the patent was granted consists in operating the signal arms of railway signals by electrical energy instead of mechanical. To this end, an electro-magnet is placed on or near the post on which is the signal arm. Each signal post and arm in a railway station is so fitted, and each is connected by wires or leads to a source of electricity, which may either be a battery or a continuously running dynamo. It is claimed that the interlocking of signals with each other and with points electrically is more safe and economical than when it is done mechanically. The levers used need only be very small, taking up little room, and the working of the apparatus is such that it can be at any time positively proved that all the points are in their proper position. The petitioner, owing to the dislike of the companies to adopt a novel and untried system in such an exceedingly serious matter as railway signalling, failed to get any of them to try the invention until 1891, when the Liverpool Overhead Electric Railway was made. That railway was fitted up with an electric signalling system arranged according to the invention, and it had been in operation ever since, proving reliable, economical, and satisfactory. It was also at work in a small way on

the Swansea Dock Railway. Owing to the cause thus indicated, the petitioner had not derived any profit from the invention, but, on the contrary, had been largely out of pocket in his endeavours to introduce the system. As the objections to the use of the system by railway companies had now been removed by the experience gained at Liverpool, there was reason to hope that it might be adopted in the future, and the petitioners accordingly applied for a prolongation of the term of the patent. The original patentees, Mr. Currie and Mr. Timmis, had obtained similar patents abroad and in the colonies, but many of them had lapsed. By an agreement between them, in 1890, the English, foreign and colonial patents were assigned to Mr. Timmis, and the American and Canadian to Mr. Currie, and they were now respectively interested in the invention to these extents.

Evidence was given in support of the petition, witnesses being called to speak to the meritorious nature of the invention. The invention had been tried with success on the Woodside branch line of the Great Northern Railway and elsewhere. The cost of the electricity for working the system on the Liverpool Overhead Railway, for 20 hours, was 6s., the system being there worked automatically by the trains. In a large station lit by the electric light the cost of working the signals by the system would be hardly noticeable.

Lord Hobhouse, in delivering their Lordships' judgment, said their Lordships were of opinion that the petitioner had established two points of very considerable merit in his invention, one being that it could operate at a distance quite unattainable by any prior system, and the other that it had the effect of releasing as well as locking the signal arms, and it was also quite clear, and not disputed, that he had not only received no remuneration, but had undergone very considerable loss in his continued efforts to bring his invention into operation. With respect to his want of success, their Lordships appreciated what had been said of the great difficulty in the introduction of such a system, that the ground was occupied by machinery of other systems, and that a new system could not be introduced except at very great cost. They appreciated the difficulty of erecting generating machinery in new countries, especially before Mr. Timmis's patent could be brought into working. Therefore, their Lordships were of opinion that it was a proper case for them to advise Her Majesty to grant an extension of the term; and in the circumstances, having regard to the great difficulties, and to the certainty that it could only be very gradually introduced, and perhaps only in the case of new railways, they thought that 10 years would not be too long a time for it to be extended.

Suckling-Baron *v.* New Zealand Electrical Syndicate.

In the Queen's Bench Division of the High Court of Justice, on Tuesday (December 14th) the trial of this action came before the Lord Chief Justice and a special jury. The action was brought by Mr. Suckling-Baron, an electrical engineer, of Parlton, near Rugby, to to recover damages for alleged wrongful dismissal, commission of 1s. per lamp fitted up by the defendant company under his supervision, and a reasonable commission on the net profits of all the agencies introduced by him to the defendants. The plaintiff (who was managing director of the defendant company in New Zealand) went out to New Zealand for them, where he superintended an installation for the supply of electricity to the city of Wellington. During the currency of the agreement the company by which the plaintiff was employed, had a receiver appointed by the Court of Chancery, and plaintiff was appointed deputy receiver at a salary of £500. The main question was, what sum the plaintiff was entitled under the altered circumstances of his employment.

Mr. Lawson Walton, Q.C., and Mr. Reskill appeared for the plaintiff; Mr. Bucknill, Q.C., and Mr. Paine for the defendant syndicate.

Evidence having been given,

The Lord Chief Justice summed up and left it to the jury to say whether the agreement was continuous; whether it was put an end to by the plaintiff, and, if not, to what notice he was entitled; and what commission the plaintiff was entitled to on the installation of electric lamps, 8 candle-power lamps being taken as the unit.

The jury found that the agreement was continuous, that the plaintiff did not end the engagement, that he was entitled to six months notice. As damages in lieu of notice, they gave him £262 10s., and they found, in addition, that he was entitled to a commission of 1s. per lamp from September, 1892, to September, 1895. They further found that he was entitled to £65 in respect of commission on agency profits.

Judgment was reserved until application, his Lordship expressing a hope that on some points the parties would put their heads together.

Salmony & Co. *v.* Theerman & Co.

Judge Lumley Smith, Q.C., tried this case in the Westminster County Court, on Wednesday. It was a claim by Messrs. H. M. Salmony & Co., electrical engineers, of Charing Cross Road, W.C., to recover, for work done and materials supplied. An item of £8, for a resistance, was the only item in dispute, for which it was contended £3 was sufficient.

For the defence, a former traveller of plaintiffs' said a 40-ampere resistance was sent, the value of which would be about £4 10s. He took the order, which was for a 50-ampere resistance.

Plaintiffs' solicitor said defendants claimed 2s. 5d. for two sample bulkheads lost by plaintiffs, and they were willing to allow for them. They were sent for the purpose of getting a quotation.

The Traveller, in reply to his Honour, said he was discharged by plaintiffs.

Defendant said he was an electrical engineer, of 12, Corporation Street, Manchester. He had contracted for an electric motor, and ordered a resistance of 45 amperes. According to the plaintiffs' list the price would be about £4 8s. He had now returned the article, and got one elsewhere for £2 16s. He lost an order through the loss of the bulkhead glasses. The resistance was not like the one he ordered from in the list.

From other evidence for the defence, it appeared that Mr. Rosenberg, a member of the plaintiff firm, would be an important witness, so his Honour said he should adjourn the case for his attendance.

Lang *v.* Wilson.

In the Westminster County Court on Tuesday, before his Honour Judge Lumley Smith, Q.C., the case of Lang *v.* Wilson was tried, which was a claim for supplying Dr. Wilson with an electrical installation. An estimate for £13 4s. 6d. was given, and extra work was done, for which an extra charge was made. Defendant said he only had the work done which was included in the estimate. In consequence of the plaintiff's cutting the bell wires he had to get someone to do some work, and he had paid £10 into Court, which he thought, after deducting what he had paid to the other man, was enough. Judgment was given for £13 4s. 6d., the amount of the estimate.

INSTITUTION OF ELECTRICAL ENGINEERS.

Report of the Council to the Annual General Meeting, December 9th, 1897.

Elections and Transfers.—The total of the additions to the Register during the year has been 216, comprising 3 foreign members, 17 members, 120 associates, and 76 students, and 53 candidates have been approved for ballot next month; 24 associates have been transferred to the class of members, and 82 students to the class of associates.

Deaths and Resignations.—The losses sustained by the Institution during the year through death amount to 22, viz., two honorary members:—Mr. Jacob Brett, Dr. Von Stephan. Two foreign members: Dr. W. P. Brix, G. Verier. Six members: John Aylmer, W. S. Graff Baker, W. H. Blakeney, W. W. Cargill, H. C. Forde, W. Moir. Ten associates: J. Auchinachie, F. V. Andersen, L. H. Chase, Paul Dimier, Capt. A. B. Hawes, F. Lilley, E. Oldroyd, A. E. Pond, G. H. Thornton, T. B. Webber. Two students: Edward Ray and C. Yatman.

Special allusion has previously been made to Mr. Jacob Brett, whose name must always be remembered as that of one of the very earliest pioneers in telegraphy, and as one of the founders of submarine telegraphy; to Dr. Von Stephan who, in his position of Postmaster-General of Germany, did so much for telegraphic science; and to Mr. John Aylmer, one of the most zealous and indefatigable of the Institution's local honorary secretaries.

Mr. H. C. Forde was one of the original members, and a former member of Council; his name was very prominently connected with submarine telegraphy, and his death was deeply deplored by all who knew him.

Two foreign members, two members, 20 associates and six students have resigned during the year.

Papers.—In addition to the very interesting inaugural address of the president, the following papers have been read during the year:—

Date,	Title.	Author.
1897.		
Jan. 28th.	Electrically interlocking the Block and Mechanical Signals on Railways.	F. T. Hollins, member.
Feb. 25th.	The Relative Size, Weight and Price of Dynamo-Electric Machines.	E. Wilson, member.
Mar. 11th.	On some Repairs to the South American Company's Cable off Cape Verde in 1893 and 1895.	H. Benest, associate.
April 8th.	Some Recent Developments in Electric Traction Appliances.	A. K. Baylor.
April 22nd.	The Generation of Electrical Energy for Tramways.	J. S. Raworth, member.
May 13th.	The Disturbance of Submarine Cable Working by Electric Tramways.	A. P. Trotter, member.
May 27th.	Dynamos	W. M. Mordey, member.
Nov. 11th.	Accumulator Traction on Rails and Ordinary Roads.	L. Epstein, member.

Annual Premiums.—In respect of papers read during the Session 1896-97 the Council make the following awards, viz:—

The "Institution Premium," value £10, to Mr. W. M. Mordey, member, for his paper entitled "Dynamos."

The "Paris Electrical Exhibition Premium," value £5, to Mr. John Gavey, member, for his paper on "The Telephone Trunk Line System in Great Britain.

The "Fahie Premium," value £5, to Mr. Benest, associate, for his paper on "Some Repairs to the South American Company's Cable off Cape Verde in 1893 and 1895."

They also award an extra premium of £5 to Mr. A. P. Trotter, member, for his paper on "The Disturbance of Submarine Cable Working by Electric Tramways."

The "Students' Premium," value £3 3s., they award to Mr. P. S. Sheardown for his paper entitled "Notes on Electric Tramway Traction," and they further award two extra premiums of £2 2s. each to Mr. F. Johnston for his paper on "Accumulators," and Messrs. R. M. Sayers and S. S. Grant for their paper on "The Working of Long Submarine Cables."

The Council desire to remind members of the increase which they have decided to make in the number and values of the annual premiums commencing with the session 1897-98, viz :

The "Institution Premium" to be increased from £10 to £25.

The "Paris Electrical Exhibition Premium," from £5 to £10.

The "Fahie Premium," from £5 to £10.

Two additional premiums for original communications not read, but accepted for publication in the *Journal* of the Institution, viz.: one of £10 and one of £5.

For papers by students read at the students' meetings—one premium of £10; two premiums of £5 each.

The Willans Premium.—Looking to the fact that the award of this premium is, according to the trust, to be made triennially, your Council, by whom the first award is to be made, have considered themselves justified in selecting for such award any one of the papers on the subject specified in the trust deed which have been communicated to the Institution since December, 1894, the date of the trust being January, 1895, and they accordingly award the premium, the value of which they have increased to £25, to Mr. Mark Robinson, member, for his paper entitled "On the Recent Development of the Single Acting High Speed Engine for Central Station Work," read May 9th, 1895.

Salomons Scholarship.—The Council have awarded scholarship of £50 to Mr. Edward Ernest Tasker, a student of the Technical College, Finsbury.

Students' Class.—The Council are glad to be able to report that the improvement in the merits of the papers read at the students' meetings, to which they alluded last year, was sustained during the past session.

Visits to the following places were arranged for the students by your secretary during the year, viz.: The works of the Electric Welding Company; the works of the India-Rubber, Gutta-Percha and Telegraph Works Company; the works of Willans & Robinson; the stations of the City and South London Railway; the Central Electric Lighting Station, Islington; the Electric Lighting Works of the Great Eastern Railway.

The Council have pleasure in acknowledging the facilities thus kindly afforded to the students of visiting works of so much interest to them.

Wiring Rules.—The new wiring rules, as finally approved by the Council, were issued at the end of July last. The revision of the former rules was carried out by the Technical Committee, comprising the whole of the Council and some other members, whose experience was such as to render their advice and assistance of special value. The Committee and its sub-committee held many meetings, and obtained both by personal interviews and by correspondence very valuable information and opinions, not only from municipal engineers and the engineers of electric lighting and power stations, but from the leading manufacturers of cables and apparatus. The rules, consequently, are based upon the experience and knowledge of representatives of all classes in the electrical profession and the electrical industry, and can scarcely fail, therefore, to be of material service to all who are engaged or interested in the employment of electric energy for lighting, heating, or motive power, &c. Although in certain respects somewhat more detailed than the old rules, they are not intended to take the place of specifications drawn up by consulting engineers, or to be regarded as other than an enunciation of the general principles which should be observed in the wiring for the supply of electrical energy.

Annual Dinner.—The annual dinner was this year held at the Hotel Cecil on November 24th, and the number of members present was larger than usual.

Annual Conversazione.—The conversazione this year was by permission of the Trustees of the British Museum, held in the galleries of the Natural History Museum, South Kensington, and was very numerously attended. Much of the success of the entertainment was due to the temporary installation of the electric light for the occasion by the Kensington and Knightsbridge Electric Lighting Company, who, at the request of the Council, kindly undertook to carry out the work at a minimum of cost to the Institution. Your Council are glad of this opportunity of acknowledging their indebtedness to their colleague, Mr. H. W. Miller, the engineer to the company, for the great amount of trouble taken by him personally in respect of the work which had to be carried out under considerable difficulties.

Building Fund.—The amount standing to the credit of this account at the date of the last annual general meeting was £3,528 4s. 2d. This year the Council in pursuance of the desire unanimously expressed by the members that the fund should be augmented from time to time as far as the finances will permit, have transferred to it from the general fund a further sum of £1,000 out of the surpluses of 1895 and 1896, which sum, together with dividends and income-tax recovered, brings the total amount standing to the credit of the fund on September 30th last up to £4,639 13s. 7d., of which £63 15s. 11d. remains to be invested.

Annual Accounts and Financial Position.—The statement of accounts and balance-sheet for the year ending September 30th, 1897, shows that the financial position of the Institution continues sound and satisfactory, the excess of the receipts over expenditure during the year being £1,080 11s.

A further amount of £185 1s. 9d. has been invested on account of life compositions, leaving at the date up to which the accounts were made up a balance of £131 6s. 5d., which has since been also invested.

The Council have the satisfaction of reporting that the amount already received in respect of subscriptions outstanding on September 30th, 1896, exceeds the estimate made in the last annual report, viz., £532.

The estimated realisable amount of subscriptions outstanding on September 30th, 1897, is £555, and none of this is taken into account in the balance-sheet now presented.

The Secretaryship.—On March 25th last your president announced that Mr. Webb desired to retire in February next from the office of secretary, which he will then have held for a period of 20 years.

The applications received in response to the advertisement inserted in the technical journals for a successor to Mr. Webb, were 48 in number, and were very carefully considered by a committee specially appointed by the Council, and certain of the candidates whose qualifications appeared to best meet the requirements, were personally interviewed by the Committee in the first place and subsequently by the Council, who finally selected Mr. Walter George McMillan, F.I.C., F.C.S., late Lecturer on Metallurgy at Mason's College, Birmingham.

Although Mr. McMillan will not actually take office until February 12th, his engagement commenced on October 1st, so that he might have ample time to make himself acquainted with the duties of his office.

The Council feel that they would be failing in their duty were they to omit to place on record their high appreciation of Mr. Webb's services to the Institution during the best years of his life. While they respect his single-mindedness, his high personal character, and those qualities which have made every member a friend, they deeply deplore the loss of his services.

ANNUAL GENERAL MEETING.

Thursday, December 9th, 1897.

The annual report of the Council, and the statement of accounts and balance-sheet for the year ending September 30th, 1897, were adopted.

The following resolution, moved by the President, seconded by Major S. Flood-Page, and supported by Prof. S. P. Thompson, vice-president, Mr. Langdon, Prof. Perry, and Mr. Mordey, was unanimously carried :—

"That, in further recognition of his valuable services to the Institution during the past 20 years, a pension of £300 per annum be allowed Mr. F. H. Webb, on his retirement from the office of secretary."

Votes of thanks were unanimously accorded to the Institution of Civil Engineers, the local hon. secretaries, the hon. treasurer (Prof. Ayrton), the hon. auditors (Mr. F. C. Danvers and Mr. A. Stroh), the hon. solicitors (Messrs. Wilson, Bristow & Carpmael).

The President announced that the scrutineers reported the election of President, Council, and officers for the year 1898. The list has already appeared in the Electrical Review.

ACCUMULATOR TRACTION.

By W. E. AYRTON.

In the interesting and concise *résumé* of the second evening's discussion on Mr. Epstein's paper, which appeared in your issue for December 3rd, I am reported as having said that it would require at least 4 H.P. to propel a 52-passenger tramcar loaded at eight miles an hour. As a matter of fact, however, if no more power than this were really needed, the shareholders of electric traction companies might retire to their country houses, and spend the rest of their lives cashing their dividend warrants.

One of my assistants, Mr. Allen, has collected the following particulars on this subject :—A tramcar, with 52 passengers in it, weighs at least 8½ tons, and frequently a great deal more. Therefore, taking 33 lbs. per ton as the tractive force on a clean, level, straight tramline, it will require certainly not less than 7½ H.P. at the wheel tyres to propel such a vehicle at 10 miles an hour. Now, under the most favourable conditions—that is, with the motors in series without any added resistance—the efficiency of ordinary tramcar motors and gearing at this speed is in practice about 70 per cent., so that the power furnished electrically must be about 11 H.P.

If this power is to be supplied by accumulators on a dummy to run with one charge for eight hours, as in Mr. Epstein's case, then we may use the values given in the following table for the capacity in watt-hours per pound gross weight of *traction* cells, which I have had calculated from their capacity in ampere-hours as given by some of the most important English accumulator manufacturers in their own price lists.

To pass from the capacity in ampere-hours to that in watt-hours, it has been assumed that the mean value of the P.D.

between the terminals of a cell is 1·9 volt during the whole of the discharge. This I find by actual experiment is correct to within a few per cent. for any ordinary storage cell that I have tested when discharged at such a rate that the P.D. begins to fall rapidly at the end of about eight hours. And since my criticism of Mr. Epstein's conclusion that $2\frac{1}{4}$ tons of accumulators will suffice for his 52 passenger tramcar is not a criticism of a few per cent. but of more than 100 per cent., it is immaterial for my purpose whether in the case of some of the cells given in the following list 1·98 volts would have been a more accurate value to have taken for the mean P.D. during the entire discharge.

Capacity in Watt-Hours per One Pound Gross Weight of Traction Cells when Discharged in Eight Hours.

Name of cell.	Type.	No. of plates.	Box material.	Watt-hours capacity per lb. (gross).
Tudor* ...	P.L.	7	Ebonite.	3·7
" * ...	"	11	"	4·0
Chloride...	T.B.	7	"	5·7
" ...	"	17	"	7·2
I.E.S. ...	A.	7	Teak and lead.	6·4
" ...	"	17	"	7·4
" ...	"	7	Vulcanite.	9·2
" ...	"	17	"	10·5
E.P.S. ...	Faure-King.	7	Ebonite.	8·6
" ...	"	19	"	10·2
Lamina ...	C.—Motor car.	5	"	7·6
" ...	"	7	"	8·4
" ...	"	9	"	8·6
" ...	T.B.—Tramcar.	7	"	10·8
" ...	"	9	"	11·8

* These cells are, however, specially made for very rapid working rates, and, therefore, would not be used when an eight hours' discharge was desired.

It is to be especially remembered, regarding the figures in this table, that they apply only to perfectly new cells, and therefore that they must certainly be diminished if we desire to know the capacity that may be expected after the cells have been in regular use for a few weeks. I should not, myself, like to rely on more than 8 watt-hours per pound gross weight of the cell; but I will take 9, so as to give the accumulator traction every advantage.

Then a preliminary calculation shows that to obtain the required 11 E.H.P. for eight hours, the weight of the accumulators must be about 5 tons. Hence, with the accumulators, dummy, and loaded passenger car, we shall have to pull not less than 14 tons. Consequently the actual weight of the accumulators required will be at least

$$\frac{14}{8{\cdot}5} \times \frac{11 \times 746 \times 8}{9 \times 2{,}220} \text{ or } 5{\cdot}4 \text{ tons.}$$

Next, how far is this result borne out in actual practice? The Paris Tramway Company uses cars to seat 50 passengers, weighing 11 tons empty and 14 tons loaded. The weight of the battery is only 3 tons; but then one charge only lasts for a run of 37 miles, in, say, four hours, instead of the eight hours taken by Mr. Epstein in the example in his paper.

Using the efficiency of gearing and motor referred to above, this 3 tons of accumulators corresponds with 8 watt-hours per pound gross weight, the value I have been accustomed to use.

Consequently, if these Paris tramcars carried accumulators to serve them for an eight hours' run, the weight would certainly have to be doubled, and become 6 tons, if we remember that, although the capacity is greater at the lower rate of discharge, the power exerted will also have to be greater, since the weight to be propelled will be increased.

Such a tramcar as I have been considering would, further, when running on a trolley line, be fitted in practice with two "G.E. 800" motors, each rated to stand an input of 40 amperes at 500 volts for one hour. The efficiency of such a motor is a maximum when it is taking a current of 25 amperes and running at a speed corresponding with 12 miles an hour. Two such motors are then producing a "draw bar pull" of 860 lbs. which corresponds with a resistance to traction of 100 lbs. per ton if we consider the loaded car as weighing $8\frac{1}{2}$ tons.

Such a resistance to traction is not uncommon on steep curves, or on steep grades combined with curves. And even when the car is running on a clean, level, straight line (and when, therefore, the real resistance to traction is only some 30 lbs. per ton) the "draw bar pull" exerted by the motors must be about 100 lbs. per ton if the car is being accelerated per second with a velocity of one foot per second.

At starting the current through each motor frequently is 50 amperes, corresponding with a "draw bar pull" of 2,000 lbs., or an acceleration per second of nearly 3 feet per second.

In stating, then, at the Institution that Mr. Epstein's estimate of $2\frac{1}{4}$ tons of accumulators for his tramcar would have to be more than doubled I was certainly not overstating the case.

THE TRANSMUTATION OF METALS.

"Pretenders to the art of making gold and silver existed in Rome in the first centuries after the Christian Era, and when discovered, were liable to punishment as knaves and impostors." The superiority of the nineteenth century is strikingly demonstrated by the different treatment now meted out to such pretenders. Organs of light and leading record their claims with apparent seriousness, and whet the public appetite for surprises by a recital of the details (or some of them), and a reference to the previous achievements (or some of them) of the wonderful genius who is to apply the factory system to gold production with an inferior metal as the raw material. We confess that we did not expect a journal of so high a reputation as the *Daily News* to devote a column in its leader pages, as it did on Monday last, to "a chapter in the fairyland of science," describing the alleged discovery of a process of turning "silver into gold." We must confess to some regret on learning that the alleged discoverer "is not an American but an Englishman."

"Over 10 years ago Dr. Emmens was well known in electrical circles here as promoter of the Duplex Electric Light Company, and inventor of an electric glow lamp with two filaments." In this capacity Dr. Emmens received some attention at the hands of the Editors of the Electrical Review. The article in the *Daily News* is headed "From a Correspondent," and the writer says: "I speak from personal knowledge when I say that Dr. Emmens is a man of the most versatile talent, able to give his mind to almost any kind of intellectual work, from constructing a dynamo to writing a farce," and this versatility of talent suggests to us a gentleman of the same name, who was the actuary and promoter of the "Mutual Society" which flourished about 20 years ago. It came to an untimely end, with results which were directly disastrous to many of those connected with it, and indirectly were much to be deplored, in that it aimed to be a provident institution having for its object the promotion of thrift. The details of the new process are "reserved," but in general it is understood to be mechanical and chemical. We are glad to note that electricity has not any part or lot in the process so far, but we rather doubt whether it can be kept out altogether. The "mechanical and chemical" are hardly sufficient to captivate public attention; mysterious and all-powerful electricity will have to be invoked. It seems to us that the inclusion in the article of the name of Sir William Crookes, F.R.S., as having identified the "artificial" metal as "gold," requires some explanation. The details of the manufacture of electric sugar were very much "reserved"—for a time—but this did not prevent samples submitted for analysis being, for the best of reasons, identified as real sugar. We are quite prepared to believe, with the *Daily News* "correspondent," that circumstances have rendered the inventor a "dark horse" in the field of science. Dr. Emmens's theory, with its "primal elements," its "new substances," and its supposition that "an atom of silver is formed by a group of three atoms of the primal element, and an atom of gold by a group of six primal atoms," and such other nonsense should be compared with the stock theory of the earlier pretenders, who supposed "that all metals were composed of two substances; the one metallic earth, and the other a red inflammable

matter, which they called sulphur. The pure union of these substances formed gold; but other metals were mixed with, and contaminated by, various foreign ingredients. The object of the philosopher's stone was to dissolve or neutralise all these ingredients, by which iron, lead, copper, and all metals would be transmuted into the original gold." The modern alchemist does not cast his net so wide, and is content to claim only the power to convert one precious metal into another yet more precious. Even a daily journal, with its ignorance of science, is sufficiently acquainted with the ways of the world to know that such claims and such efforts at publicity have a business side. Factories must be started before product is turned out, and patent rights must be secured before participation in profits is possible. Upon some such plausible pretexts the magician plays upon gullible members of the public with the aid of the public press. It is one of the invariable laws of history that manufacturers of gold require to be "financed;" and editors of daily journals should remember that we are now in the nineteenth century, when we cannot expect the exercise of the wisdom of the fifteenth. When Augurello pretended to teach the art of making gold, he dedicated his treatise to Pope Leo X. He subsequently applied for some reward, when "the Pope, with great ceremony and much apparent kindness and cordiality, drew an empty purse from his pocket and presented it to the alchemist, saying that since he was able to make gold, the most appropriate present that could be made him was a purse to put it in." Is it too much to hope that Dr. Emmens's efforts at obtaining gold may be similarly met?

CORRESPONDENCE.

Incandescent Gas Burners.

I think electrical engineers ought to be very grateful to Mr. Medley for furnishing them with a refutation of the ridiculous statements which are so frequently made concerning the value of the incandescent gas mantles, and also to yourselves for your excellent leader on the subject.

Mr. Medley's tests are far more complete and valuable than those which I have had the opportunity to make, but it may interest you to know that I have taken a very large number of observations of the illumination produced in a street by means of incandescent mantles. My measurements were made with that excellent little instrument the Preece-Trotter illumination photometer, and I am glad to find that Mr. Medley's tests confirm the most striking fact to which my experiments led me, viz.:—the rapid decrease in the light giving power of the mantles.

I do not at present consider myself at liberty to give you full particulars of my tests, but I hope before long to be in a position to add the small weight of my testimony to that of Mr. Medley by publishing the results of my work.

I am frequently coming across sensational statements by interested parties as to the value of incandescent gas mantles, and also with evidence of the effect which those statements produce, and I thank Mr. Medley for providing me with such powerful assistance in my endeavours to combat the erroneous impressions which are so strong and so widespread.

A. A. Voysey.

Electrical Department,
Commissioners of Sewers.

The paper by Mr. Medley, "Some Tests on Incandescent Gas Mantles," published in your issue of the 10th inst. was most timely.

The public are to be invited early in the new year to invest in a re-organised Incandescent Gas Light Company with a capital of £3,500,000, which is to acquire the shares of the Incandescent Gas Light Company, of the Irish and of two Austrian Share Companies. The assets of these existing companies consist of the patents of Carl Auer von Welsbach, which expire in two years, and the plant of a concern in Vienna which manufactures the fluid employed in impregnating the Welsbach mantles.

It is difficult to conceive a more "*cheeky*" undertaking than this proposed attempt to sell to the public a property which inside two years will have practically but little value whatever. As Mr. Medley pointedly says, "as soon as the master patent for the Welsbach mantle expires, that is about two years from this date, this country will be flooded with mantles 'made in Germany' and elsewhere." And as Mr. Medley proved by his tests at least one of these mantles "made in Germany" is far superior to those sold here by the Incandescent Gas Light Company.

The master patent, No. 15,286, of 1885, expires December 12th, 1899, a few days less than two years from this date. When that occurs the Incandescent Gas Light Company has no protection against those who choose to make and vend Welsbach mantles. It requires very small capital to set up in the business of mantle making. The materials thorium and cerium nitrates can be purchased of a half dozen chemical manufacturers in Germany, the thorio at 43s. per kilo, and ceria at £15 per kilo. The proportions in which these two are combined in making the impregnating fluid are 99 per cent. of thoria to 1 per cent. of ceria. A kilo of the fluid contains 300 grams of thorium nitrate and 10 grams of cerium nitrate, the rest, 690 grams being distilled water. The cost, therefore, including labour will be less than £1 per kilo.

The Austrian Company, which now supplies all the Welsbach Companies with impregnating fluid, receives £2 per kilo. It stands to reason that after 1899 no one will pay £2 per kilo for a fluid which a boy, who can weigh out the ingredients, can compound at a cost of less than £1 per kilo.

The secretary of the Incandescent Gas Light Company is busily engaged in circularising the public, offering special terms to all who will send in applications for the shares of the proposed new company. And small wonder that this course is being pursued when the public is to be induced to relieve the present holders of their shares at a premium of 66⅔ per cent.!

The British public has often been misguided, but it is to be hoped it will not put £1,641,425 in hard cash into the pockets of the present holders of incandescent shares, and in addition bestow £365,000 upon those who are working the scheme.

G.

In his paper on the above subject in the current number of the REVIEW, Mr. Medley does not state if steps were taken to keep the burners clean. I suppose most users of incandescent gas lamps have noticed what a wonderful effect the cleaning and blowing through of a burner, which has been in use for two or three months, has on the light; it quite gives the lamp a fresh lease of life. Mr. Medley states that the lamps were burnt continuously day and night; it would be interesting to know, therefore, if precautions were taken to prevent the burners from becoming clogged.

It occurred to me that this clogging of the burner might possibly account for the irregularities in the curve for the five C burners, fig. 1, though one would think the gas consumption should show similar variations, which apparently was not the case.

S. H. Blake.

[I should have stated in the description of my incandescent gas mantle tests that both burners and chimneys were regularly cleaned; so that the irregularities in the life curves could not have been due to any clogging of the burners, as suggested by Mr. Blake. The light from the mantles is, of course, diminished if the burners are not kept properly clean.—E. A. MEDLEY.]

Distribution of Electrical Energy.

It is interesting to note in last week's ELECTRICAL REVIEW, an attempt to justify the use of high tension alternating currents for the supply of electricity to towns and districts in this country.

Twenty-seven towns having adopted one system, and 19 the other, proves little or nothing, unless the practical results attained from the use of both systems are investigated.

It may be safely assumed that when a local authority or limited company are granted the necessary Parliamentary powers to supply electric light and power to any special district, naturally, the first consideration would be the public safety, and how to invest or spend to the best advantage the money placed at their disposal.

Any one planning the best method to adopt for the lighting of any district in London or the provinces, and wishing to avoid the possibility of fatal accidents would never think of using H.T. alternating currents in the face of about 20 fatal accidents having occurred in England alone through their use, especially as we have no record of any fatal accident having occurred through the use of continuous currents.

Such being the case, where is the justification for its adoption? Certainly not through its earning capacity, as £1,000 invested in central stations where continuous currents are used earns more money than £1,500 invested in central stations where H.T. alternating currents are used.

Let me cite an example. The City of London Electric Lighting Company, Limited, invested up to 1896 £1,127,960, and the net earnings derived from so large a sum for the year was £50,960.

The Westminster Electric Supply Corporation, Limited, invested £478,870 and earned during the year £54,978. It is almost unnecessary to state that the first company named use H.T. alternating currents, and the latter continuous currents with accumulators.

It is, I may say, a waste of ink to refer to the many disadvantages connected with the use of two-phase H.T. alternating currents for arc lamps and for power. To put it plainly, the results for both purposes are most unsatisfactory compared to the advantages to be derived from the use of continuous currents.

In fact, the supply of power will ultimately become a most important feature in all industrial centres, and the time will come when central stations will have to be changed from H.T. alternating to continuous, or else powers will have to be granted to other corporations to provide what the existing local authorities or corporations are unable to supply.

If all the central stations in this country had been erected on the lines of Manchester, Bradford, Brighton, Charing Cross, Chelsea, St. James's and Westminster, investors and ratepayers would have been better off by at least two millions sterling, and the serious and unnecessary sacrifice of life would have been avoided.

A. L. Fyfe.

The Beanes Ozoniser.

The injudicious criticisms made by Mr. E. Beanes of the point-bearing electrodes, which I use for producing ozone, and his claim to the discovery, 30 years ago, of the ozoniser consisting of flat plates, which he considers to be the best producer of ozone, have compelled me to put things in their true light, and to state in a most formal manner, that under the same conditions of working, point-bearing electrodes (especially when facing flat plates, an arrangement which I prefer), give at least 20 per cent. more ozone than flat plates alone.

I will not insist on the superiority of the points, but disclose this very unpleasant fact for Mr. Edward Beanes, that he is not the inventor of the flat plates ozoniser or condenser, and in case there is any doubt as to the accuracy of my statement with regard to the flat plates ozoniser which was devised by Du Moncel more than 10 years before Mr. E. Beanes introduced it in this country, and which was constructed under the direction of G. Jean, I will supply the following evidence:

No sooner had the Beanes ozoniser been shown in 1868, at the Société d'Encouragement, than the chemist Jean published in *Les Mondes*, T. xvi., p. 229, a letter of protest, in which he said that the Beanes apparatus was the same which he had described in June, 1864, in *Les Mondes*.

Later on, in 1873, there is in the *Bulletin des Comptes Rendus de l'Académie des Sciences*, T. lxxvi., page 1203, a note by the same Jean, on the "Decomposition of Carbonic Acid by the Electric Effluvia," in which he refers to a paper sent to the Académie in 1865, and published by the journal *Les Mondes*, in which he described his apparatus which was exhibited in the Seguy stand at the Paris Exhibition in 1867. He adds that his condenser, consisting of *flat glass sheets*, allowed him to obtain a great surface for the production of ozone in large quantities. An abridgment of this note by G. Jean, on "Ozone, and the splitting up of carbonic acid into ozonised oxygen and carbonic oxide under the influence of electricity," will be found in the *Chemical News*, December 15th, 1865.

When, in 1866, Mr. Beanes patented a process for bleaching sugar (No. 2,645), he had no apparatus of his own, and in his specification he says most positively: "I do not claim any particular class or form of apparatus or vessels, neither do I claim *any particular mode of producing ozone* . . . . but what I do claim, and desire to secure by Letters Patents, is the application of ozone in treating saccharine matters." We can, however, safely say that it was in 1867, just a little after Jean had his ozoniser at the Paris Exhibition, that the first Beanes apparatus was constructed in this country. We infer this from the following extract from the *Inductorium, or Induction Coil*, by Henry M. Noad, Ph.D., F.R.S., F.C.S., published by Churchill & Sons, in 1868, page 114: "At the commencement of last year an apparatus was designed by Mr. Edward Beanes, and constructed by Mr. Ladd, for producing ozone. . . . . The apparatus was made as follows: 30 plates of thin glass, 18″ × 9″, each plate being coated with tinfoil on one side, and separated from those next it by slips of glass placed along two edges, so as to have a series of thin broad channels for the passage of the air to be ozonised, each coating being alternately connected together in a similar way to a condenser of an inductorium. The area between the plates was about 14 square inches, the two terminals of the coatings are insulated through the box, and when connected with a good inductorium, a glowing discharge will be seen between the plates of glass, and as one discharge is sufficient to ozonise the air at that instant between the plates, it is evident that a rapid blast can be sent and an enormous quantity of ozone obtained."

I would trespass too much on your space were I to quote all the passages from the books and scientific publications which go to prove that the ozoniser which bears the name of Beanes, was known long before Mr. Beanes had constructed one. Du Moncel, in 1853, first discovered the glow of the silent discharge in a flat plates condenser; then he noticed that, while experimenting with the Rhumkorff coil, ozone was formed, under the action of the induction current, between two flat glass sheets, coated with a metallic foil. This fact can be ascertained by referring to the *Notice sur la machine Rhumkorff*, by Du Moncel, second edition, 1857, p. 63.

With regard to the production of the glow of the silent discharge, who can contradict the statement made in the *Philosophical Magazine*, Vol. xiii., p. 63, 1857, by W. R. Grove: "Mr. Du Moncel has shown that when two plates of glass, coated respectively on their exterior with metallic plates, kept separate and electrised, a brilliant electric light is seen between the plates."

Emile Andreoli.

In the last number of the Electrical Review, page 826, is a communication from Mr. Emile Andreoli on ozone generators in which he states that Du Moncel used flat plates in 1855. Will you kindly grant me a small space to enable me to correct Mr. Andreoli's statement by his own writings?

Mr. Andreoli is author of a pamphlet published in 1893 which purports to be a bibliography of "Ozone: its Commercial Production and its Application;" he states that the figures and comments are carefully compiled from all *reliable sources*.

The author gives at page 7 the date of 1868 as that of the production of my condenser.

On page 10 of the same pamphlet he mentions "the experiments of Du Moncel on the electric discharge between two metallic plates separated by a piece of glass as having occurred in 1871." It looks very much as though my criticism on Mr. Andreoli's point bearing electrodes may have influenced his later opinion.

With regard to the term "heretical," Mr. Andreoli would appear to consider as heretical all opinions that do not coincide with his own particular orthodoxy.

Edwd. Beanes.

Re Shoreditch and its Dust Destructor.

Your correspondent, Mr. Kershaw, seems to be somewhat offended, in that some of your correspondents are anonymous—but surely nothing has been advanced in any of the communications that need be other than anonymous—without the writers being ashamed of their names.

Mr. Kershaw says "We have nothing here that we wish to keep secret, nor anything we are ashamed of." I do not doubt this for one moment. Mr. K. has undoubtedly nailed his colours to the mast—that is to say, the men who advised him with respect to the entire scheme—but that does not do away with the fact that large expectations, so fulsomely put forth at the opening ceremony, appears very far from fulfilment. By the bye, Mr. Editor, does Mr. K. mean, when he says that "he does not intend to be drawn into a newspaper controversy," that he does not intend to answer your own very businesslike queries? I trust for his own sake he will do so.

A few days since a copy of the "proceedings" at the "opening," reprinted from the *Shoreditch Observer*, July 3rd, 1897, was forwarded to me, and I can assure you, Mr. Editor, that it was a treat, a feast of eloquence, and a flow of soul, more than charming—and then the banquet. "At this juncture," says the before-named paper, "'The light of other days' was turned down, and, amidst the hearty applause of the company, the chairman switched on the 'light of the future.'" Mark the word, "the future," "the future." The reason why I emphasise the word "future" is simply this—that I have a recollection of a certain lecture delivered by Prof. Forbes, in 1892. He said, speaking of the refuse at Paddington, "If used in the most economical way it would be found that (assuming the proportion of lighting required for such a population to be, as has been very generally assumed, one lamp per head) the amount of refuse provided by any population is almost exactly as much as is required to supply the illumination by means of the electric light to that same population." I admit that one of Prof. Forbes's well known "ifs" comes in, but suppose we make a liberal allowance and divide the "one lamp per head" by two, and say half a lamp per head—how will that come out, Mr. Editor, for Shoreditch. 124,000 population at half a lamp, ought to be 62,000, but we are told that all the house refuse of Shoreditch, with half ditto of St. Giles, plus 30 tons of coal per month, has given the magnificent result of 250 kw., say 7,000 8-C.P. Where the balance of the "light of the *future*" is to come from is a mystery to yours obediently

X. Y. Z.

How to Cure a Magnetised Watch.

A simple method of curing magnetised watches which, I think, is not generally known, has been used by my partner, Mr. De Puydt, ever since he made his first dynamo (over 20 years ago). It consists of hanging the watch to a string, twisting the latter, holding string and watch near a magnet or a dynamo, releasing the watch, and whilst it is revolving, carrying it away (not too abruptly) from the magnet or dynamo.

The demagnetisation is due to the rapid alterations of the poles of all the magnetised parts in a magnetic field that is decreasing in force.

M. Poncin.

[This method is well known, and one that we have ourselves frequently recommended.—Eds. Elec. Rev.]

Wireless Telegraphy.

I notice on page 818 an editorial comment which appears to be based upon some incorrect reporting, of unknown source, of a lecture recently delivered by me at the London Institution. The report is incorrect in more ways than one. It gives an erroneous title to my lecture, and it makes me out to have said, what I most emphatically repudiate, that Mr. Marconi "had done" nothing. What I did say, and now repeat, is that he had *discovered* nothing; and that is a very different matter. What he has done all the world knows. He has succeeded by the use of Hertz waves in sending signals first to a distance of three miles, then to a distance of about nine miles across intervening space. So far as I am aware, before his three mile success the greatest distance to which Hertz-wave signals had been sent was 1¼ miles. The advance from 1¼ miles to three miles and then to nine miles, is a real achievement that I have taken some pains to explain and to describe.

The circumstance that so many Marconi myths are now afloat makes one the more careful in the terms one uses. As an illustration, after my lecture a gentleman from the audience came up to inform me that I was in error in saying that Marconi uses Hertzian waves. He said he had previously attended some other lecture (by whom I did not inquire) where the lecturer explained the difference, and demonstrated by diagrams how, while Hertzian waves spread in every direction, like light or sound, from their origin, the Marconi waves went only in a direct straight line to the place where the coherer was! He seemed much to resent my assurance that he must have been hoaxed, and was firmly convinced that Marconi waves don't spread!

Silvanus P. Thompson.

[Prof. Thompson may not have intended to say that Mr. Marconi had done nothing new, but we are perfectly satisfied that he used that expression.—Eds. Elec. Rev.]

THE ENGINEERS' STRIKE.

The adjournment of the Conference in a state of complete disagreement has been followed by an appeal of the men's executive to the men themselves, and the result seems to be that the strike is to continue. The men's leaders appealed to their constituents, we incline to think, in a faulty manner. The question was put before them as a special pleading. The men were told they were to be smashed as trades unionists, and were confidently expected to vote in favour of continued idleness. The employers protest against the unwarranted assumption that they have any intention of smashing the Union, and there seemed no other end in view but a fight to exhaustion. The men are fighting, or are supposed to be fighting, against the different payment of different men. They are demanding equal wages for all, or, what comes to something very like it, they are asking a certain minimum wage for every man, though they are not confining membership of the Union to men who are worth the minimum demanded.

Mr. John Burns alone seems to be arguing against further struggle. He at least tells the men they had better knuckle under at once unless they can get at least £15,000 guaranteed weekly for six months. This implies victory in six months, but victory is not likely to fall to the men in six months. The employers have determined to persist: they know they cannot accept Mr. Barnes' nomination and keep out of bankruptcy, and if they are to be bankrupt they may as well be so sooner, as a few months later. The employers, in a sense, are driven to make a last stand for life and liberty. They can but lose, and naturally argue they may as well die fighting. It is not so with the men. If the masters lose, the men can only lose later, as the masters become bankrupt. If the men lose the fight they will at once go back to work on good wages, and before long will be earning better money. But if the men are not careful, they will, before long, find themselves the tag end of a worn out strike, while the engineering shops will gradually fill up with men trained on more modern ideas, and who realise that output is necessary to successful trading.

The truce came to an end on Tuesday, December 13th, and the speculations of men are busy as to what will occur. Either the men must go back to work or the strike area will be widened and lock-out extended by the completion of notices which were pending and have been held over the Conference. Mr. H. H. Howorth, that free-lance and thorn-in-the-side of his party, writes to the *Times* severely criticising the action of the Board of Trade as fatuous. He ridicules the ballot to be taken, describing it as a farce. The men's ballot, he says, is always put in the form of a vote of confidence in some leader who first addresses the men in a fervid speech, and as the leaders seem so sure of getting further funds, the men, he thinks, will vote for further fighting; all the time their leaders are fighting to save their skins as much as for any particular issue. Mr. Howorth points out the illegality of some of the grants to the men from co-operative and other societies, and describes strike pay as a miserable pittance. With winter coming he thinks it pitiful for men who have earned large wages and have families, and it is pitiful, so much so, indeed, that did we not think this struggle means life or death to English engineering trade, we would be strongly tempted to write against our convictions and in favour of the men. But we cannot do so. We could just as well write against Crompton, or Hargreaves, or Arkwright, of spinning renown, against Heathcote for his lace machinery, which was to ruin all lace work, and has improved it a hundred fold, against Richard Roberts, for inventing the planing machine, and throwing out of work the men who had to chip and file lathe beds. The men have put their trust and lives into the hands of a set of men whose rule has all been against the employment of machinery and reduced cost of output. Their stand is incomprehensible in this year 1897. All experience is against it, American practice is a huge obstacle right ahead of the shattered barque of trades unionism of the new school.

If the object of the men is really a shorter working day they have, for some years, gone about their purpose in a curiously contradictory

manner. That the use of machinery has been a large factor in shortening the hours of labour must be pretty well conceded by everybody. That the ultimate end of machine production will be still shorter hours we may also allow probable. America may be pointed at as an example to the contrary. Machinery is largely employed, yet the hours of labour are long. But in America long hours are the result of much business. A continent has been filling up, and the demand for labour has often exceeded the supply. Americans, moreover, are exceedingly conservative, far more so in many respects than the English. Years ago America was ahead of Europe generally in its labour conditions, and in the freedom of its people, and what was the case then is still believed to be the case to-day by the bulk of the people, who have remained content with conditions that would not be tolerated in England, simply because such conditions are believed to be better. If the A.S.E. is anxious to secure the eight hours' day, why not start information bureaux amongst the Americans and the Germans, and disseminate plain ungarbled facts as to the position in England, with a view to equalising conditions. If it be granted that machinery has rendered proper an eight hours' day, then let eight hours be made universal; let the boasted brotherhood of labour recognise this. We see no objection, but a great deal of good, in the eight hours, and should be glad to see the time arrive for its adoption, but we do not think the time has come. When we see 10 or 12 hours Germans and Americans doling out starvation grants to encourage English nine hours' men to strike for eight hours, we confess to a feeling of disgust for our countrymen's gullibility and the foreigner's hypocrisy. Why should the most favoured workmen be the ones selected to fight the hours' battle? Strike pay, a mere fraction of the Englishman's wages, would be half or two-thirds the German's weekly wage. Why should not the A.S.E. get up a German strike, and subscribe to keep it going? Small as are his wages, the German workman knows better than to listen to men like Mr. Barnes. If machinery is to reduce the hours of labour, why is its output kept so low by the A.S.E., for it is to output alone that machinery owes such influence as it wields in this direction. Look at the question from what point we will, not a ray of reason can be discerned in the attitude and claims made by the men. They have approached the position in face of the most obvious obstacles to success.

The only good we can foresee from the strike is, that the conditions of English labour have been made so widely known to the foreigner, that in other countries pressure may be brought to bear which will more closely approximate conditions to those existing in England. For the English workmen the worst result of the strike has been the complete exposure of trades union methods. Labourers have been producing more than skilled men were doing. Boys have been surpassing the output of their fathers, or men of similar age. In an ordinary strike of short duration the loss, inconvenience, and general irritation arising from the training of raw hands to fill strikers' places has been very irksome, and the end of a strike soon brought back the old hands. But the present strike has gone on nearly half a year; the worst of the above evils have been overcome. The green hands are so no longer, but are well on the way to become as efficient as they ever can be made. There are not the vacant places to be filled up, and when the strike is over there is likely to be a rush for places. *Sauve qui peut* will be the order of the day.

What has been the effect of the many strikes upon English trade? According to Mr. Gastrell, the commercial attaché to the British Embassy in Berlin, our trade has been shrinking while that of Germany has been expanding. We have no fault to find with the expansion of the trade of Germany, so long as such expansion is not at the expense of our own trade by reason of our own folly. In the first nine months of this year our export trade fell off 4½ millions, and that of Germany increased nearly 3½ millions. This looks very like a piece of simple exchange. Germany is, of course, reaping the benefit of the French indemnity, which gave power to Germany's new efforts. To secure export trade Germany subordinates railway rates and gives bounties, and, moreover, has the support of her own workmen, who are not led astray by any frothing self advertiser, who may be struggling to Westminster on the flesh and blood of the unfortunate families of his deluded followers. The *Standard* of December 9th points out how a strike enables a labour leader to pose before the public, making speeches, playing games of bluff, to quote Mr. Maddison, standing up to railway boards and playing equal to all sorts of bigger personages. Then the free high living at hotels, with funds to gather and spend, all mean benefit to a strike leader. But where do the men come in who find the funds? In the present strike they have lost a quarter of a million of accumulated funds, and possibly two millions of unearned wages. Yet no shop has stopped work from which the strikers have departed.

We believe the Employers' Federation are absolutely firm in their intention to refuse the eight hours' demand, and to keep or regain control of their own shops. If the strikers would believe this, of course, the strike would end at once, but the strikers do not believe it. They have been induced to believe they will gain their ends; foreign competition has been declared a phantom, and the employers have been set up as a perpetual gold fountain from which wages can stream forth to any amount the employers' greed allows him to grant. The employer is not recognised as being simply a medium of exchange and reservoir in the cycle of production, as a clearing house to apportion income to wages' account, materials' account, and profit. Yet that is all that an employer really is, and before he can act as employer he must have something in his reservoir to fill the circulating pipes and leave a margin. If the men realised that trade could not continue they would abate their demands. But they do not think, and we gather that large numbers of men are paying their levies simply out of fear of being deprived of old age pensions. Such is the state of subordination to the executive to which men have now been brought down. Their servants have become their masters.

The Conference again met on Tuesday and continued on Wednesday, the latest word prior to going to press being that the prospect was hopeful. It appears to us that this resumed Conference after the men's ballot is simply an easy way of getting out of a difficulty. The employers stated originally they did not wish to smash the Union; the men say the Union is to be smashed, and are asked to vote, not so much on the proposals at the Conference, as upon whether unionism is to be smashed—a sort of abstract idea introduced evidently for a purpose. The employers repeat and emphasise that they do not wish to smash the Union. *Ergo*, they have been forced to this by the men's ballot, and so the employers having simply restated the fact, the Conference resumes, and peace at this present writing seems probable.

Colonel Dyer's Statement.

Colonel Dyer occupied the chair at a meeting of the Manchester District Engineering Trades Employers' Association, held last week to hear his account of what took place at the recent Conference. He said that although they failed to come to a definite conclusion, he believed that they had threshed out very many points of difference, and they had come very close to a satisfactory conclusion to both parties. The first question submitted by the employers was that they should have perfect freedom in their works. The Employers' Federation did not define the word "freedom" in the way in which it had been defined in some of the papers—that was, to do as they liked in their works. They had no such wish. All they wanted to do was to have the whole of the works in the Federation on what might be termed the most-favoured-nation clause; that was to say, that in any work which was being carried on in one workshop in the Federation all the other members of the Federation should have equal advantages that one member had. They did not wish to interfere in any way with the functions of a trade union. It was not intended in any way to interfere with the functions of the trades unions, but employers must have freedom in their own works. He took it that the functions of the trades unions were to see that their members were not oppressed, to endeavour to raise the status and the wages of their members, to see that they had freedom of bargaining with their employers, to serve as benefit societies for the more provident of their members, and generally to act as caretakers of their members. When once trades unions passed beyond those functions and travelled into the province of the employer, they went beyond what was right and proper. The masters were specially careful to show that they did not wish in any way to abrogate the proper functions of a trades union. Coming to the question of freedom of employment, that freedom meant that everybody in England was a free man, and had a perfect right to sell his labour as he chose. The masters did not interfere with the trades unionist; but, on the other hand, they would not let the trades unionist interfere with a man who exercised his freedom not to be a trades unionist. A rule adopted last year by the Amalgamated Society of Engineers provided that anybody who refused to work with a non-unionist workman should receive strike pay as a matter of course. Now, he felt that nobody in that room would justify such a course of action. Every man in England was a free man, and it behoved everybody to put their best energies forward to support that freedom of action in others which they claimed for themselves. The next question that came up was piecework. Objection had been made that they were doing away with the power of collective bargaining between the employer and the workman, that the workman was alone and unsupported by his union, and that, therefore, the employer might take advantage of him. Now, he believed he was quite right in saying that no employer in the trade would try to grind his workmen in an unjust and dishonourable manner. He did not believe that employer existed; but, if he did exist, he would not be countenanced by the Federation. Then they added the clause:—"The Federation will not countenance any piecework conditions which will not allow an efficient workman to earn at least the wage at which he is rated." That clause was put in to let the workmen know that the Employers' Federation would not support one of their own members if they found that the workman was being oppressed by any individual member inside the Federation. What they wanted was this, that the employer himself should arrange with his individual workmen the terms upon which each should work piecework, and why they wished it to be done between the employer and the workman was because the employer alone knew the conditions under which the workman was going to work. The conditions under which two pieces of work had to be done in different factories might vary in every respect. The employer and the workman alone knew what appliances were at the disposal of the workman to do the work. But the trades unions said "No." They themselves wanted to fix what each individual employer should pay to each individual workman, and that was wrong on the face of it. Why should a single employer have to face a large society, and why should employers be obliged to open their works to trades union delegates, who fomented discord between employer and workman? One trades union delegate on the north-east coast had said in a speech, that the functions of trades unions were to keep the employers lively, and make them bow down to the trades unions. Nobody was more in favour of trades unions than he was. He believed they were a necessity of civilisation, and that they had done an immense deal of good; but, at the same time, they had done an incalculable amount of harm. What they now wanted to do, and what they were determined to do, was not in any way to do away with trades unions, but to do away with their power of doing evil, destroying the trade of the country, and interfering, in a way, between master and man, which raised bad blood and ill-feeling. What they wanted to do was to have good feeling between themselves and their workmen, and they could not do it if they were to allow outside interference. The Employers' Federation

would help the trades unions to see that workmen were not oppressed, that workmen were not unjustly treated, and that their conditions of labour were improved as far as possible; and that as regarded their wages, the Federation would, when the state of trade warranted it, be ready to give an increase to their workmen. They did not want the trades union to force them to do it, but they would do it because they considered it was a just and a right thing to do. He might say that at the end of the Conference the men's delegates agreed to accept the terms which they had proposed for piecework. With reference to overtime, workmen as a body looked upon it as a means of increasing their earnings, but his own opinion was that overtime was a mistake. He was perfectly certain that systematic overtime could not benefit an employer, and it would be far better for him to increase his plant rather than go on constantly working systematic overtime. For this reason the Employers' Federation urged upon the men that they would urge upon their different members to do away with systematic overtime. They had a long discussion upon that, and they made a proposal that they should ask all their members to limit their overtime as far as possible to 40 hours a month. The men had been asked to agree to this limitation, and the employers thought that was fair and equitable, because it did not follow that, because there was the ability to work 40 hours a month overtime, they were going to do it. In fact, hundreds of employers would not work any of it, while some would be obliged to. Many, instead of working overtime, preferred double shifts, under which circumstances overtime was very small indeed. But it stood to reason that an employer should have certain powers of working overtime. It was not because they wanted to work overtime, but because they could not help it, and under the circumstances, they must have the power of doing so. Everything was agreed to except the last clause, and that was not disagreed to. Some newspapers had said that if the employers had the right they would exercise it constantly to work overtime whenever they pleased. That was not intended at all; but was it a likely thing that any member would say that under no circumstances would he go and have an hour or two more overtime, even in special circumstances, unless he had the permission of the trades union delegate? They were not going to have a trades union delegate to boss their works. The next point was the rating of workmen, and it was absolutely necessary to insist upon the right to pay each workman according to his ability, and to engage or retain men at such wages as they could earn. He was assured that at one of the Conferences—not the last one—an employer asked some trades union delegates what he was to do with the old men to whom he could not pay what was called the standard wage. The answer, which lacked somewhat in humanity, was "Chuck them out; their unions will look after them." He was told that in one case this had been done, and the old men were tramping the streets suffering little short of starvation. If that was trades union humanity he would resist it to the last. The trades unions might say to any one of their men, "You shall not work under a certain sum of money," but when they called upon the employer to enforce that rule, it was the time for the employer to say he declined. Employers would not make themselves instruments of the trades unions, and that was the sum total of their objection to what was called the minimum wage. Then the masters claimed that there should be no limitation of the number of apprentices. The number of apprentices being educated by the Government Departments was miserably small compared with the number of men employed, and so keenly is the want of these apprentices felt, that representatives of the Government were going about to the different industrial centres to endeavour to get up 500 young men for engine room artificers on board the fleet. The next question was the selection, the training, and employment of operatives, and it was perfectly obvious that the employer alone could be the judge of what class of men he is to put upon his various machines. Some machines could only be worked by a man of the highest skill, but there were others which any child could work, and many machines wanted no working at all, except simple feeding. To say that a trades union delegate was to fix the rate of wages for working machinery was simply going back 50 years. Further, many of their machines they did not want everybody to know about, and they did not intend that they should know about them. There only remained the last clause regarding the machinery for preventing further disputes between themselves and their workmen. It was perfectly obvious that it was not the principle of collective bargaining if a single employer was to meet the whole strength of a trades union. After this came the question of hours. The men demanded 48 hours, and the employers simply had to wait until the men's delegates proved that a 48 hours' week was more favourable to the trade of the country than the 53 and 54 hours they were now working. It was necessary, before any diminution in the hours of labour took place, that it should be proved to the satisfaction of both employers and the public that the trade of the country was not going to suffer. The men's delegates presented no case to answer in any way. They simply reverted to the old statement that certain firms worked the 48 hours, and liked it. If some firms cared to take out their dividends in philantrophy he had no objection, but they should not ask others to do it. He mentioned firms and quoted figures to show that the 48 hours' system was of itself condemned. It was all very well for certain firms, supported as they were undoubtedly by the Amalgamated Society of Engineers, with the object of making this 48 hours a week a success; but was it likely, if the whole of the firms in England took up the 48 hours, that the whole force of the trades unions was going to force their men to make them all a success? Most certainly not. It was a fact that the delegates who had been formulating their demand for 48 hours all through the country had told him that they had never considered the subject. After hearing this from the delegates, he really thought it was hardly worth while to go into a long discussion about the merits of the 48 hours' question; the discussion having broken down, he thought it best to leave it alone. In conclusion, Colonel Dyer said that the employers proposed no alteration in the existing conditions as regarded the functions of trades unions and their right to make what rules they pleased as to work and wages for their own members, but the employers objected to being made parties to enforce those rules, and they objected to any trades union interfering directly or indirectly with work or wages of men not belonging to their union. The employers simply required the trades unions to refrain from encroaching on the management of the workshops. Beyond that they proposed methods in co-operation with the trades unions for negotiating and adjusting wages, and for avoiding trade disputes in the future. Their plan of settlement was essentially one of collective bargaining between the Federation and the trades unions, instead of between the individual employer and the trades unions. The very specific character of the agreement which they proposed to the allied trades unions afforded a material and emphatic answer to those who asserted that the employers declined to recognise, and desired to destroy, the trades unions. The employers had no such wish; they never had such a wish. They wished to preserve the trades unions; they wished to keep them within their proper functions, and one of their functions was certainly not to interfere in the management of the workshops or in the business of employer. It was Socialism which had caused the whole of the dispute, the new militant trades unionism which wanted to force upon the country and the employers at large a Socialist propaganda which could not fail to ruin the country if it was allowed to exist. The employers were perfectly willing, and ready, and anxious, when trade warranted it, to increase wages in a reasonable manner, and they did not want the trades unions to help them to do it. He believed—he said it honestly—that the Employers' Federation was the kindest friend that the British workman ever had.

Mr. Coventry moved the following resolution:—"That this meeting hereby expresses its unabated and perfect confidence in its representatives at the recent Conference, and cordially thanks them for the most equitable proposals which they have enunciated for the future regulation of engineering workshops."

Mr. West supported the resolution, which was carried.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week Ending Dec. 14th, 1896	£	s.
Adelaide	66	0
Amsterdam	30	0
Auckland	32	0
Bilbao	583	0
Calcutta	199	0
Compana. Teleg. mat.	172	0
Cape Town	895	0
Christiana	24	0
" Teleg. wire ...	24	0
Delagoa Bay	43	0
Durban	764	0
East London	508	0
Flushing	122	0
Melbourne. Teleg. mat.	198	0
Ostend	44	0
Passages	425	0
Port Elizabeth	200	0
Rangoon	39	0
Rio Janeiro. Teleg. mat.	66	0
Rosario	97	0
Rotterdam. Teleg. mat.	52	0
Santos	316	0
" Teleg. mat. ...	570	0
Stockholm. Teleg. mat.	96	0
Suez. Teleg. mat. ...	9,360	0
Sydney	1,406	0
Vera Cruz	37	0
Total	16,408	0

Week Ending Dec. 14th, 1897.	£	s.
Adelaide	42	0
Amsterdam	120	0
Auckland	21	0
Bombay	26	0
Boulogne	11	0
Brisbane	184	0
Calcutta...	14	0
Cape Town	1,096	0
Christiana	269	0
Constantinople	13	0
Durban	120	0
East London	180	0
Flushing	263	0
Gibraltar	2,212	0
Gothenburg	110	0
Hamburg	85	0
La Plata	11	0
Liban	50	0
Lisbon	25	0
Madras	30	0
Malaga	375	0
Melbourne	393	0
Naples	50	0
Novorossisk	64	0
Ostend	18	0
Port Elizabeth	50	0
" Teleg. mat.	773	0
Stockholm	100	0
" Teleg. mat. ...	375	0
Sydney	270	0
" Teleg. mat. ...	333	0
Wellington	179	0
Yokohama.	480	0
Total	£8,342	0

Foreign Goods Transhipped.

	£	s.
Flushing...	39	0

Bankruptcy Proceedings.—At a sitting of the London Bankruptcy Court held on Tuesday last before Mr. Registrar Linklater, S. Bousfield Tatham, electrical engineer, 26, Thurloe Place, South Kensington, applied to pass his public examination upon accounts showing total liabilities £2,534 11s. 10d. (unsecured £2,510 8s. 1d.) and assets £41 2s 1d. In the course of his evidence, the debtor said he traded from 1889 to 1895 in partnership with others at Davis Street, Berkeley Square, but in August of the latter year, in consequence of disagreements which had arisen in respect of betting losses he had incurred and paid for by overdrawing his

partnership share, he withdrew from the firm. Since January, 1896, he had traded by himself, first at 6, Gloucester Terrace, and then at Thurloe Place, until last October, when his stock and fixtures were sold under an execution. He ascribed his insolvency to extravagance in living, betting losses, and law costs. The examination was ordered to be concluded.

Catalogues.—We have this week received a number of catalogues of electrical apparatus and fittings. The Crystal Electric Lamp Company has sent an illustrated price list of incandescent electric lamps manufactured at its works at Kempston, in Bedfordshire. Many classes of lamps are included. There are standard lamps, high efficiency, high voltage, focus, fairy, frosted, the "Victoria," and fancy lamps.

The Edison & Swan United Electric Light Company, has brought out its fancy fittings, electroliers and brackets' catalogue (Section VI.). The company make a speciality of such fittings for public buildings, mansions, churches, hotels and theatres, and it is therefore not surprising that the list, which, by the way, is well arranged and beautifully printed, has some very neat and artistic designs. At the end of the book, of over 100 pages, are some illustrations and particulars of figures in imitation bronze, terra cotta, and Doulton ware.

The General Electric Company issues a new edition of its Section O catalogue, relating to electro-medical supplies. This list, which has called for a great deal of care and attention in its compilation, comprises all the requisites for faradisation, galvanisation, electro-cautery and Röntgen ray apparatus. There are over 200 illustrations showing the various apparatus. Amongst the many articles found in the book, which undoubtedly forms a most useful collection of apparatus for electro-medical purposes, are various types of coils, with and without cells, magneto machines, batteries, switches, electrodes, cautery outfits, telephonic apparatus for the sick room, testing instruments, rheostats, dental electro-motors, spark coils, vacuum tubes, and many sundries, including the Edison phonograph.

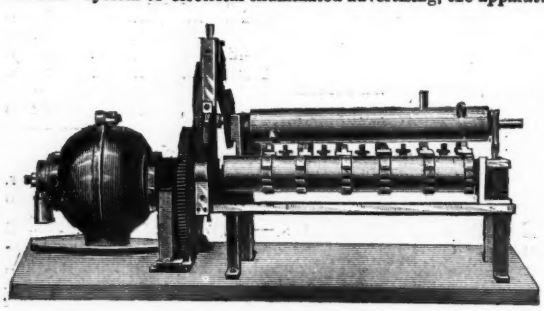
The Brush Electrical Engineering Company, Limited, has sent an advance copy of a new catalogue and price list of engines, dynamos, motors, alternators, transformers, &c. We find that in this list there is very exhaustive information in tabulated form, giving capacities, dimensions, and so forth, of the plant described, an excellent feature being the inclusion of weights and measures on the metric system as well as the English. That this will have a good effect with some customers abroad we have not much doubt. It is a point which has repeatedly been emphasised by our Consuls abroad, and is worth doing. The Mordey-Victoria alternators, Brush "Inductor" alternators, Brush-Vienna direct current dynamos, Brush series dynamos, alternating current single-phase motors, are described, and the "Universal" steam engine is shown, combined with the company's various types of dynamo machines. The Mordey-Victoria transformers, Brush standard switch fuses, for high and low tension, lightning arresters, Brush-Geipel automatic regulators, arc lamps and accessories, incandescent lamps, alternating current automatic cut-out, automatic cut-in incandescent lamp switch for series working. This is an outline of what the book contains. The paper and printing and the binding, in cloth covers, is all that could be desired, and the illustrations are of the first order.

Chloride Accumulators.—The Chloride Electrical Storage Syndicate, Limited, inform us that they have received instructions to supply a complete set of cells for Her Majesty's yacht *Victoria and Albert*. This battery is exactly similar to that supplied some time ago to the Prince of Wales's yacht *Osborne*, which, we understand, has given complete satisfaction.

Dissolution of Partnership.—Messrs. Thos. Harrison and Charles Smith, trading under the style of Harrison & Smith, electricians and engineers, at High Bridge, Newcastle-on-Tyne, have dissolved partnership. Debts will be attended to by Thos. Harrison.

Ediswan Lamps and Fittings.—The Edison & Swan United Electric Light Company have secured contracts for the supply of incandescent lamps to the National Telephone Company, the Great Western Railway Company, and the contract for the whole of the electrical supplies, including lamps, to the West Sussex County Asylum, Chichester. The company are exceptionally busy in all branches of the works, and have in hand very large orders for switchboards, ship fittings, electroliers, &c, besides a number of Government orders.

Electrical Advertising.—We illustrate Gent's patent "Allaxic" system of electrical illuminated advertising, the apparatus



shown being provided with a "Lundell" electric motor. A novel purpose to which this system is applicable is for the illumination of goods in shop windows. The goods to be illuminated are displayed on suspended frames, having an electric lamp or gas burner fixed in the upper part, so arranged that the light itself is not seen but is reflected on the article to be noticed. These frames are hung about the window in different positions, each having articles displayed upon them for sale. Each frame of the series is illuminated in turn, *but always in varying order* after being extinguished, thus as each frame is lighted up attention is drawn to the goods, and the interest maintained so that what is seen is fixed on the memory. For exhibiting a series of large outside advertisements the wall space is divided into sections which can be lighted up separately, each section having a transparent front on which the advertisement appears, each of the sections are illuminated in irregular order. A complete apparatus in working order was recently exhibited at the Royal Cornwall Polytechnic Society's Exhibition, Falmouth, with great success. The whole of the signs, letters, wall advertisements, and display frames for goods in shop windows, are attractive as day advertisements, and are made by the Allaxic Advertising Syndicate, Birmingham.

Fined.—The Mayor of Croydon last Friday fined Reginald Cornish 5s. (and 14s. costs), for fraudulently using a telephone instrument of the National Telephone Company. He was not a subscriber, but by means of a false key obtained use of a call box instrument at Norwood without payment.

Improved Glow Lamps.—A list of these lamps has been issued by the Improved Electric Glow Lamp Company, Limited. Extracts are printed from a report by Dr. E. Hopkinson of tests made by him. The circular gives some figures as to increased candle-power obtained from these lamps and the reduced cost; but on these points we would refer our readers to an article in the Electrical Review for August 7th, 1896.

River Plate Imports.—The *Review of the River Plate* says that, according to the National Statistical Department, the the imports of electrical apparatus during the year 1896 were as follows:—

Galvanised iron wire—16,440 tons, valued at $1,036,972 gold, of which Germany supplied 6,884 tons, Belgium 4,113, United States 2,103, France 8, England 3,332.

Dynamos—33, valued at $9,306. Germany 18, Belgium 7, France 6, England 2.

Supplies for electric light—Valued at $151,745. Germany $19,978, Belgium $6,962, United States $92,871, France $5,762, Italy $2,690, United Kingdom $24,482.

Cables and wires—62 tons, value $38,846. Germany $8,376, Belgium $3,654, United States $11,205, France $1,446, Italy $883, United Kingdom $13,462.

Incandescent lamps—8,921 dozen, value $26,763. Germany 4,935 dozen, Belgium 845, United States 2,610, France 71, Italy 71, United Kingdom 389.

Telephone material—Value $11,020. Germany $1,292, Belgium $6,888, France 485, England $2,355.

Telegraph material—Value $10,540. Germany $100, Belgium $4,310, United States $230, Paraguay $1,610, United Kingdom $34,125, other countries $165.

The Incandescent Electric Lamp Company, Limited.—This company, the makers of the well-known "Robertson" incandescent electric lamps, have just taken possession of their new building which has been erected at Brook Green. This building will enable the company to more than double the output of the "Robertson" incandescent electric lamp, and has been necessitated by the greatly increased demand.

Water Power.—According to a Glasgow daily, a committee of the Greenock Water Trust have had before them applications from syndicates as to the water power, and the charge therefor. The committee have resolved to grant water to the Aluminium Roller Mill Company on stated terms. This company will have works—employing about 500 persons—in the vicinity of the Victoria Harbour.

ELECTRIC LIGHTING NOTES.

Acton.—The District Council is appointing a committee to take expert advice on the matter of electric lighting.

Belfast.—The electrical engineer has reported to the Electric Committee the results of his tests at the contractor's works of 8½ miles of cable, and the first steam dynamo and boiler, all part of the plant ordered for the new installation. The erection of the station buildings is to be pushed forward. The question of the alteration of the system of charging to the Wright system has been considered by the committee and will come up again.

Bo'ness Docks.—Messrs. Thomas Meeks & Son, engineers, and Mr. Carlow, to whom the electric lighting question for the harbour and docks was referred, have purchased two engines, dynamos, and the other plant necessary. This was purchased from the Public Library at Edinburgh. Contracts are to be given out for fitting up the installation. There will be about 20 lamps round the dock.

Buxton.—The ratepayers were addressed by Prof. Kennedy, the other day, on the progress of municipal electric lighting. The Professor will prepare a report for Buxton. The meeting passed resolutions disapproving of the Council putting down its own installation. There seemed to be a feeling in favour of the proposals put forward by a private company.

Bootle.—A Local Government Board inquiry was held on 10th inst. regarding the Council's application for a £35,000 electric lighting loan. Mr. Farmer (Town Clerk) explained the scheme. The total was made up as follows:—Buildings, £6,000; laying mains, £2,695; Mr. Miller's scheme for the electrical plant, £23,152; spare armatures, £540; an additional return wire, £700. There was no opposition to the scheme, and the inspector afterwards paid a visit to the central station site.

Bristol.—The Town Council on Tuesday had its attention called to electric lighting matters by a report from the Electrical Committee, to the effect that the contemplated extensions of street lighting by arc lamps would cost £23,000. They recommended this sum be borrowed, plans for proceeding with the work having been prepared. The Council agreed to the committee's recommendation, and during the speech-making upon the subject, Mr. Pearson, the chairman of the Electrical Committee, mentioned that the alterations and additions to the central station would increase their output so that they would be equal to 80,000 lamps.—Electric lights will enter largely into the scenes at the pantomime at Prince's Theatre, Bristol; in one scene alone 600 lamps will be used.

Cardiff.—There was another discussion last week regarding the many months overdue contracts for electric lighting plant.

Chichester.—The Town Council discussed the electric lighting question at length the other day, a proposal being before it from an electric lighting company, whose terms were considered favourable. The Council is applying for a provisional order.

Clerkenwell.—The Electric Light Committee has visited several municipal electric light plants, and a few days ago it was decided to inspect the Brighton station.

Crieff.—Strathallan Castle, Perthshire, has been fitted up with an electric light installation. The motive power for generating the electric current is obtained from the river Machany.

Dartford.—Mr. R. P. Wilson has been appointed to act as consulting engineer to the Dartford Urban District Council.

Dublin.—The letter from the Tramways Company proposing to purchase the electric lighting undertaking, is to be considered by a committee of the whole house. This communication has been published in the Review.

Dundee.—A sub-committee is considering the tenders submitted for the extension of plant at the electric lighting station.

Exeter.—The Electric Lighting Committee has reported that the posts were fixed and wired ready for lighting the main streets of the city by electricity, but the surveyor was still waiting for the lamps, which the contractors were prevented from delivering in consequence of the engineers' strike.

Glasgow.—The Town Council decided on Monday to utilise the electric tramway poles for electric lighting.

Gourock.—The Electric Lighting Committee has been inspecting the Edinburgh electricity works, and a visit will probably be paid to Fort William.

Hammersmith.—The Vestry last week considered a scheme submitted by the Electric Lighting Committee, prepared by Mr. Preece, for electric lighting extensions. It is proposed to extend the plant to meet any likely demand in the present or extended area during the next 15 months. It is proposed to extend the public and private lighting mains. The engine room is to be lengthened so as to make room for three new engines and dynamos of double the present size. This addition will cost £2,500. The capacity of the generating plant will be increased so as to enable it to supply, allowing 30 per cent. as spare plant, 15,000 8-C.P. private lamps burning at one time and 150 arc lamps. The estimated cost will be £10,600. Fifty new arc lamps will be required at a cost of £2,610. The extensions to mains will cost £4,825. Eight sub-stations will cost £1,440. Meters, demand indicators, consumers' connections, will amount to £2,000, that is allowing for 200 customers. Contingencies, £1,025. The Vestry has adopted the scheme which will cost somewhere about £25,000.

Hull.—The City Council has increased the salary of Mr. Barnard, borough electrical engineer, from £250 to £350.

Ipswich.—After going into the question of lighting for the new Workhouse and considering an estimate from Messrs. Taylor and Field, electrical engineers, a committee advised the Board of Guardians to go in for electric lighting in preference to gas. The Board, however, deferred a decision until an estimate had been sent in by the Gas Company.

Islington.—At the meeting of the London County Council last week, it was decided to lend the Islington Vestry £14,250 for electric lighting purposes.

Leeds.—At a meeting of the Parliamentary Committee last week, the Town Clerk (Mr. Harrison), and the City Accountant (Mr. Derry), reported on the legal and financial aspects of the proposed purchase by the Corporation of the undertaking of the Yorkshire House-to-House Electricity Company. After a lengthy discussion, in which reference was made to Mr. Justice North's decision in the Sheffield case, it was resolved that the City Council be recommended to authorise the Parliamentary Committee to apply for the necessary provisional order to acquire the company's undertaking. A sub-committee was appointed to draw up a report on the subject.

Leith.—The Electric Lighting Committee recently had the plans for the lighting of the district before it. The total number of arc lamps required for the compulsory area is 68.

Leyton.—Various matters connected with the electric lighting undertaking came before the District Council last week, one of these being a recommendation of the electrical engineer and Electric Lighting Committee that extensions be carried out costing £20,000. This proposal was referred back for a month.

Liverpool.—The Street Lighting Committee inspected the principal thoroughfares the other night to examine the lighting. Previous to the tour, the Chairman of the Committee, Mr. Petrie, entertained his colleagues to dinner, and gave the following particulars *re* the city lighting. He remarked that the total number of street lamps of every class in Liverpool was 14,254, lighting 409½ miles of streets, 561 passages, and 1,350 courts. Of these 133 were electric lamps, lighting 3¾ miles of road, and 1,593 were incandescent gas lamps, lighting 32½ miles of road. The work of the year had included the fixing of 97 arc electric lamps, lighting 2½ miles of road, 1,194 double incandescent lamps, lighting 19¼ miles of road, 108 single incandescent lamps, lighting 1¾ miles of road, 181 ordinary lamps, lighting 7 miles of road and 248 passages, lighting 6,244 back doors. It was proposed, in 1898, to light an additional 27 miles of main arteries of the city by means of 1,077 incandescent gas lamps, in lieu of ordinary ones, and to fix lamps in 400 passages hitherto unlighted, in addition to the lighting of new streets. The estimates for street electric lighting had not yet been finally arranged, as they would probably be largely governed by the operations of the Tramway Committee, in connection with electric traction for street cars.

The Lighting Committee last week considered and passed their estimates for 1898. They propose during next year to expend the sum of £136,987 in extension of electric supply, chiefly to provide electric energy for the new trams, and also motive power to private consumers. The year's expenditure for electricity on revenue account was estimated at £46,030; but the profits, it appears, will fully cover all charges on the additional outlay. The expenditure for gas and street lighting, including the fitting of 27 miles of main thoroughfares with incandescent lamps, was estimated at about £46,700.

Manchester.—A special meeting of the Electricity Committee was held on Monday, for the purpose of discussing the proposed supply of electric light and power to various districts in the neighbourhood of Manchester, whose Urban District Councils are desirous of treating with the City Council for such supply. In the case of an application from Withington, it was arranged to hold a special meeting to meet a deputation appointed from the Withington Council.

Monmouth.—In consequence of the approaching completion of the electricity scheme, the Corporation has given a contract to the Gas Company for public lighting for six months only.

Newington.—The Vestry has decided, pending the provision of a central generating station for the parish, to light the new stables by electricity from the baths installation, and an electric motor provided with oat-crushing machinery, maize and bean splitter, chaff cutter, lifting hoist, friction hoist, shafting and belting, &c., with all cutting, fixing, &c., at an estimated cost of £509 5s., being an excess of £180 over the estimate for chaff cutting, &c., by means of a gas engine and lighting the building by gas. It was stated that the £180 in excess of the estimate would, by the use of electricity, be saved in the first two years.

Northwich.—The first installation of electric light in Northwich was completed on Saturday last. The current is being supplied by the Northwich Electric Supply Company, Limited.

Shoreditch.—The Lighting Committee submitted to the Vestry on Tuesday, last week, a report prepared by the chief electrical engineer, Mr. C. Newton Russell, on the question of lighting East Road, New North Road, and Kingsland Road, which he recommended the Vestry to light by two circuits of 21 lamps each; and he recommended a similar plan for the lighting of Hoxton Street, Hyde Road, and Hackney Road. In the case of the first three streets, three-way conduits are already laid on one side of the carriageway. Mr. Russell estimates, says *London*, the cost of this important extension at £6,930, and, when completed, almost all the chief thoroughfares will be lighted by the electric light. The Lighting Committee have now received applications for the supply of current equivalent to 18,900 8-C.P. lamps. Once more they have had to refuse Bethnal Green a supply of current. The Guardians at first applied, and now the Vestry have asked for more light, but having regard to the increasing demands of Shoreditch, the Committee find it impossible at present to undertake to supply current in any considerable quantity in Bethnal Green. The Committee have given a guarantee for the amount of steam required for the baths and washhouses; but they have had some difficulty with the contractor as to the removal of clinker and the accompanying *olla podrida* of tinware, &c.

South Staffordshire.—At a meeting of the Darlaston District Council last week, a deputation from the Midland Electric Corporation for Power Distribution Limited attended, and explained its objects, and the terms upon which they were willing to supply electricity for public and private lighting, and for manufacturing purposes.—Formal application was made for the Council to sanction the scheme, and after a long discussion the matter was referred to the General Purposes Committee.

Sowerby Bridge.—It is stated that a number of electrical engineers in the Sowerby Bridge district are considering the advisability of lighting the town by electricity.

St. Helens.—The Health Committee last week decided to appoint Dr. Hopkinson as adviser and arbitrator in connection with the erection of the proposed destructors at the Boundary Road depôt. Dr. Hopkinson was recently appointed to advise the Council on electric traction.

Stirling.—An application for a transfer of the electric lighting order held by the Corporation to Edmundson's Electricity Corporation, Limited, came before the Police Commission on Monday.

St. Pancras.—The Vestry has approved of extensions to Highgate, the total cost of the scheme being £7,585. The charge for current is to be reduced at the beginning of the year to 6d. per unit at first, and 3d. after three hours per day.

Tees.—The electric lighting and motive power installation which has been put down by Messrs. Ernest Scott & Mountain, Limited (Mr. J. G. W. Aldridge acting as supervising electrician), for the dry dock at Cargo Fleet, was completed last week, and a trial run was made last Friday under the superintendence of Mr. Mountain and Mr. Aldridge. It is stated that with 10 powerful arc lamps the docking and undocking of ships could be undertaken at night with comparative ease and safety as well as in the day time. The plant is as follows:—Two vertical double-cylinder, double-acting, high-speed engines, each engine capable of giving 30 effective H.P. with a steam pressure of 35 lbs. per square inch when running at a speed of 300 revolutions per minute, and fitted with cylinders 10 inches diameter by 8 inches stroke. The engines are complete with continuous lubricating gear, and the speed of each engine is controlled by centrifugal governors, driven by belt from the crank shaft. The engines drive by belt on to two "Tyne" dynamos, each dynamo being capable of feeding an equivalent of 800 16-C.P. lamps, the machines being constructed to give an output of 175 amperes at an E.M.F. of 105 volts when running at a speed of 900 revolutions per minute. The dock is lighted up by 10 arc lamps of 3,000 nominal C.P. each, each lamp burning with a current of 15 amperes for 16 hours without recarboning. The workshops are also lighted by four arc lamps of 1,000 C.P. The arc lamps are run in pairs, each pair being controlled by a switch and adjustable resistance, and the lamps are suspended from poles fitted with suitable head gear and counter-balance weights. The workshops and offices are further lighted by 47 incandescent lamps, there being four 8-C.P. lamps, 35 16-C.P. lamps, and eight 32-C.P. lamps. Twenty-four 32-C.P. incandescent lamps are supplied for lighting inside vessels and under ships' bottoms, each of these lamps is fitted into a watertight portable lamp, with 100 feet of armoured flexible cable to each. From the distributing boxes, electric motors will be driven for drilling and other purposes in the repairs of vessels of all classes.

Torquay.—It is expected that the electric current will be available on January 15th.

Waterloo.—The Liverpool District Lighting Company quoted £266 for erecting six electric lamps in certain part of the district, the Council to supply the standards. The Council has not accepted the tender. The Chairman stated "that the tender did not include anything beyond wiring and providing the lamps. The lighting would cost 2s. 6d. per hour."

Westgate.—The District Council, on 9th inst., resolved to apply for an electric lighting provisional order.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Aberdeen.—The Tramways Committee is to procure from Manchester, Sheffield and Glasgow copies of the reports on various systems of traction, with a view to their being circulated amongst the members.

Airdrie and Coatbridge.—It is understood that the British Electric Traction Company's application for light electric railway powers is to be opposed by the Coatbridge Town Council.

Cardiff.—The Public Works and Electrical Committee considered last week whether the roadways through which the electric tramways would run should be paved with wood blocks or granite setts. Wood blocks were favoured.

Coventry.—Another large English order for iron goods and machinery has, says the *North British Daily Mail*, just been booked by American manufacturers, a commission having been received from Coventry for the supply of 1,500 tons of tramway rails and 900 tons of electrical machinery.

Gateshead.—The shareholders of the Gateshead and District Tramways Company, on 9th inst., passed unanimously the following resolution:—"That this meeting of shareholders approves of, and adopts, the agreement made November 12th, 1897, between the Gateshead and District Tramways Company and the British Electric Traction Company, Limited." The shareholders in the present company will have the option of exchanging their shares for 6 per cent. preference shares in the new company, or selling out for £4 15s. per share. The shares are at present quoted at from £4 12s. 6d. to £4 17s. 6d.

Grimsby.—The Tramway Company has undertaken to reconstruct the tramway track, and in communicating with the Highways and Public Works Committee, the directors say that the directors had taken into consideration, as they had to re-lay the whole system, the fact that the Grimsby Corporation were considering the advisability of establishing an electric lighting system. If this scheme was carried out, they desired to know whether the Corporation would be prepared to supply the Tramway Company with the power for traction purposes. If the Corporation could, the directors thought they could give a promise that they would be prepared to put down heavier rails, bonded with copper, and to meet the Board of Trade requirements for electric traction. They wished to know the views of the Corporation on the matter. The Lighting Committee is to go into it.

Hanley.—The Town Council will oppose an application by the Electric Traction Company for an order to promote an electrical tramway, commencing in Tontine Street, Hanley, and proceeding by way of High Street, The Hollows, and Leek Road to Burslem.

Leamington.—The General Purposes Committee have declined, says *Daily Tenders*, to entertain an application of the Electric Extension Company, asking for an extension of the present tramway lease on expiration, as they have entered into negotiations with the local tramway company for the purchase of their undertaking.

Post Office Motor Mail Carts.—The *Automotor and Horseless Vehicle Journal* says that the General Post Office authorities have within the last two or three days arranged a contract with Messrs. Julius Harvey & Co. for the regular conveyance of parcel mails between London and Redhill, to commence last night. The van to be employed will be on the "Lifu" steam principle, and will have to carry all the heavy Christmas mails as a start.

Salford.—A deputation has been on a visit to Glasgow, making inquiries *re* the working of the tramways, and into the proposed Springburn scheme.

Southampton.—There was a report by the Parliamentary Committee before the Council last week on the proposed acquisition of the tramways. It dealt with the terms and conditions of the purchase, and said that having consulted counsel, the sub-committee did not recommend that the basis of purchase submitted by the Tramways Company be entertained. They recommended that the matter be submitted to arbitration, Mr. Joseph Kincaid, of Westminster, being appointed arbitrator for the Corporation. The Corporation discussed these proposals in committee, notwithstanding several protests made by members against that course.

Spain.—An order for 160 cars for the new electric tramways in Barcelona has been given out by the Sociedad de los Tranvias de Barcelona to the Sociedad Material de Ferrocarrills y Construcciones of that city.

Sunderland.—Negotiations are pending, says *Daily Tenders*, between Sunderland Tramway Company and the Town Council with a view to extending the local tramways and improving the service by adopting electric traction.

TELEGRAPH AND TELEPHONE NOTES.

Bermuda-Jamaica Cable.—The ss. *Scotia*, with the Bermuda-Jamaica cable, manufactured by the Telegraph Construction and Maintenance Company, leaves for the West Indies early next week.

Commissioners of Sewers and the Telephone Tubes.—At the meeting of the City Commission of Sewers on Tuesday, on the motion of Mr. A. C. Morton, the court resolved to prosecute an appeal to the Railway Commissioners from the judgment of the judge of the City of London Court in the dispute between the Commission and the Postmaster-General as to the use of underground tubes by the National Telephone Company.

Delays in Australian Telegrams.—The patience of the public has been much tried by the inconvenience arising from interruptions and delays on the Australian land lines. As long as such delays are confined to telegrams of a purely commercial nature, little is said either by the mercantile community or by the press, but when news of an international cricket match is awaited, a good deal of attention is bestowed on the shortcomings of these lines. Thus we find complaints in the daily press, at present, of delays on Australian telegrams; in one case we are informed that the delay is due to the land line between Port Darwin and Adelaide having been washed down by floods on Thursday, the 9th (current), and the traffic being thus diverted over the Roebuck Bay cable is consequently a cause of delay. We have frequently referred to the inefficiency of the Roebuck Bay route, which is ostensibly an alternative route to the Port Darwin line. It is an interesting coincidence to call to mind that on the occasion of the first match played in New South Wales on December 18th, 1894, both land lines across Australia were interrupted for a day; and a month later, during the continuance of the matches, both lines were again interrupted for five or six days. We do not suggest that this proves any connection between cricket and telegraphy, but it may be that delays which are patiently tolerated

by business men are strongly objected to by those interested in sport, and so the knowledge which on other occasions may be suppressed, becomes public during the cricket season. Some time ago we read in the columns of the *Times* the reply to a protest which had been made to the Premier of South Australia by the London Chamber of Commerce, calling attention to "the delays in the transmission of messages" to and from Australia. The reply to this protest is signed by Sir C. Todd, Postmaster-General of South Australia, and is dated August 31st last, and states that "delays have very rarely occurred;" and further on says, "as a rule messages are transmitted very quickly over the line between Adelaide and Port Darwin, and our difficulties as regards the new code have been completely overcome; I do not, therefore, anticipate any further complaints." We are sorry that we cannot endorse the opinion expressed in this letter of August 31st, neither as to the rarity of the delays nor as to the sanguine anticipation advanced; as since January 7th of this year (when the line was interrupted for four or five days) there have been altogether, as far as can be gathered, seven cases of interruption, of which three have occurred since August 31st. These interruptions refer only to the Port Darwin line, and do not include delays occurring on the West Australian line, nor those which happened on the Java landlines during the time that the solitary cable between Singapore and Australia was broken down. Doubtless the Postmaster-General of South Australia feels it incumbent on him to advocate the landlines as strongly as he can, for on his shoulders rests in a great degree the responsibility for the attitude assumed by the South Australian Government in relation to the Pacific cable project, which would form a really alternative route to Australia. This gentleman in a letter to a member of the South Australian cabinet, reporting against taking part in the survey for the Pacific cable, writes with an unconscious humour in reference to the scheme, "as the Government are aware, I have given this subject very great and careful consideration, more so, perhaps, than any one else," but as in the same letter he also refers to "the enormous depths of the Pacific estimated at 12,000 fathoms in some places," we take the liberty of discounting the opinion which he expresses of his own opinion on at least this subject, to say nothing of the delays on Australian landlines.

Glasgow Telephone Inquiry—The *North British Daily Mail* of 10th inst. says:—"A rumour was current in the city last night to the effect that Sheriff Jameson has reported in favour of the contention of the Corporation—namely, that they should be entrusted with a license to establish a municipal telephone exchange. On inquiry, we learn that no such intimation has reached Sir James Marwick, the town clerk." "Our Edinburgh representative interviewed Sheriff Jameson last night in regard to the rumour. The Sheriff refused to be drawn on the point. Sheriff Jameson stated that he sent off his report fully a week ago to the Treasury Department, addressing it to Sir Francis Mowatt, one of the permanent officials, from whom he had received his instructions. Although a week had elapsed, he had received no official acknowledgment of the receipt of his communication. In the circumstances Sheriff Jameson felt obliged not to divulge the nature of his report, which, so far as he was concerned, was at present of a private character. Although he had received no official reply, he had reason to believe, from private communication which he had received, that his report was being considered at head-quarters. Sheriff Jameson explained that in the course of the inquiry many points suggested themselves to him which were not mentioned in the scope of his reference, and on these side questions he had ventured to make no remark. For instance, he had made no recommendation with regard to what action should be taken in the year 1911, when the telephone licenses expire. This was a point which was not included in the questions addressed to him by the Treasury, at whose instructions the inquiry was undertaken. He had reason to believe, however, that the Treasury Department were anxious to have some information on this point, and if he received instructions, he would be quite prepared to furnish them with a supplementary report on this view of the question, besides explaining any other points which had not been included within the scope of his inquiry. Pressed to give some indication as to the nature of his report, Sheriff Jameson said he could not conscientiously divulge its contents, but he laughingly declared that it would not please any of the parties concerned. He had been approached by several people interested in the telephone inquiry, but he had been obliged to be obdurate in every case. Only that day he had been solicited by the agent for the National Telephone Company, but even to that gentleman he had to turn a deaf ear. The only consolation he could give him was to advise him to write to the Treasury Department for a copy of the report, as one of the parties interested. Sheriff Jameson stated that he was totally ignorant as to what procedure would be followed to make the report public; but he had no doubt the Treasury Department would furnish the public with the contents of the report. Being only a departmental inquiry, he doubted whether the report would be laid on the table of the House of Commons, but in any case the parties interested should be able to get a copy from the Treasury Department. With regard to the delay which had occurred in acknowledging receipt of the report, he considered that the Department was earnestly considering its details, and possibly they might desire some information on points which had not suggested themselves when the terms of that reference were drawn up."

Huddersfield Telephones.—The General Purposes Committee has made a recommendation to the Council to seek to obtain permission from the Postmaster-General for the Corporation to acquire municipal control of the local telephone service.

Interruptions in Cables to South Africa.—Since writing last week, we learn that the San Thomé-Loanda cable has been repaired, but only to be informed a day later that this cable had broken down again, and is still interrupted. This is the third interruption to this section within the last six weeks, during which time this cable has only been working about a week. These interruptions to this section entirely cut off communication with the Cape and South Africa by the West Coast route. The proprietors of these cables may derive some melancholy satisfaction from the thought that the frequent interruptions to their lines furnish them with an argument in favour of the establishment of a system of cables from Gibraltar to Cape Town *vid* Sierra Leone, Ascension, and St. Helena. This is doubtless becoming more and more necessary as far as the Cape is concerned; but the small dependence which can be placed on the Cape route is certainly not a reasonable argument in favour of making this route an alternative means of communication to Australia as has been suggested.

Norwich Telephones.—A large public meeting was held here on 3rd inst. to consider what steps to take to ensure cheaper and better telephonic communication than at present. A resolution was carried impressing upon the Norwich Corporation the necessity of applying for a license from the Postmaster-General to establish a municipal exchange. A committee was appointed to follow the matter up.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (Anglo, 1869)	April 6th, 1893 ...	...
West Indies—		
St. Croix-Trinidad ...	Nov. 30th, 1896 ...	...
Amazon Company's cable—		
Parintins-Itacatiara ...	May 5th, 1896 ...	...
Obidos-Parintins ...	Dec. 7th, 1896 ...	...
Otranto-Vallona	Oct. 11th, 1897 ...	...
Vigo-Borkum	Nov. 28th, 1897 ...	...
San-Thomé-Loanda	Dec. 4th, 1897 ...	Dec. 12th, 1897.
" "	Dec. 13th, 1897 ...	...
Sitia-Rhodes	Dec. 7th, 1897 ...	Dec. 10th, 1897.
Landlines.		
Trans-Continental line beyond Masol	March 12th, 1896 ...	...
Carthagena - Barranquilla (Columbia)	July 4th, 1896 ...	...

Telephone Service in London.—The following report on this subject was presented by the Highways Committee at Tuesday's meeting of the London County Council:—We have proceeded upon the reference made to us by the Council on October 12th, 1897, to report "what steps can be taken to investigate the present position of the telephone service of the metropolis." It will no doubt be remembered that, owing in great measure to the pressure brought to bear by the Council, the House of Commons in 1895 appointed a Select Committee (of which Mr. J. W. Benn was a member) upon the subject, the reference being as follows:—"To consider and report whether the provision now made for the telephone service in local areas is adequate; and whether it is expedient to supplement or improve this provision either by the granting of licenses to local authorities or otherwise." The Select Committee received evidence relative to the telephone service in London and other cities and towns, and Mr. W. H. Dickinson, who was then deputy-chairman of the Council, gave evidence on behalf of the Council of the defects of the present system, and submitted estimates, prepared by the Council's engineer and by Mr. J. L. Newland, of London. The Select Committee subsequently, in reporting on July 1st, 1895, the evidence taken, stated that it had not, in view of the approaching dissolution of Parliament, had time to consider its report, and recommended that a committee on the same subject should be appointed in the next session to consider and report upon the evidence already taken, and, if necessary, to take further evidence. The Committee has not, however, been re-appointed; and nothing further has been done by the House of Commons in the matter. Recently, however, the Glasgow Corporation having applied to the Postmaster-General for a license under the Telegraph Act, 1892, for a municipal service there, he considered that to enable him to decide whether a license should be granted, an inquiry should be held in regard to the telephone service in Glasgow, in order that he might have the benefit of an independent and local investigation into all the points at issue. A commissioner accordingly held such an inquiry, his attention being particularly directed to three points as to the existing telephone service, viz. (*a*) efficiency, (*b*) adequacy, (*c*) charges; but his report has not yet been published. We are of opinion that it would be a public advantage that a similar inquiry to that which recently took place in Glasgow should be held respecting the telephone service in London, having regard to the complaints which have been made of the high charges prevailing, and of the inadequacy of the system for the requirements of the public; and we therefore recommend:—(*a*) That, with the view of obtaining an investigation with regard to the telephone service in London, similar to the inquiry recently held as regards that service in Glasgow, the Council do make an application under the Telegraph Act, 1892, to the Postmaster-General, for a license empowering the Council to provide an independent municipal telephone service for the County of London. (*b*) That the Highways Committee be authorised to take all necessary measures to give effect to the above resolution.

CONTRACTS OPEN AND CLOSED.

OPEN.

Bilbao.—February 28th. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul at

Bilbao, reporting that the provisional board appointed in connection with the electric tramway which it is proposed to lay from Zumarraga to Zumaya, in the province of Guipuzcoa, invite plans and tenders, to be received by February 28th, for the construction and equipment of the line. Further particulars of the conditions of the tenders for the above-named tram line and branch, which together measure 30 miles, may be inspected at the Commercial Department of the Foreign Office any day between the hours of 11 and 6.

Bedford.—January 10th, 1898. The Electric Light Committee want tenders for the supply and erection of a 420 B.H.P. double-acting compound enclosed engine, and a 250-unit alternator with stationary armature. See our "Official Notices" December 10th for particulars.

Bootle.—January 10th, 1898. The Corporation wants tenders for the supply and erection of boilers, engines, dynamos, switchboard, pumps, transformers, wiring, alteration of Town Hall wiring, batteries, mains, street boxes, and the running of the electricity works for three years. Consulting engineer, Mr. T. L. Miller, 7, Tower Buildings, Water Street, Liverpool. See our "Official Notices" December 10th for further particulars.

Canterbury.—December 20th. The Corporation Electric Lighting Committee is inviting tenders for the supply of Lancashire boilers, and boiler house plant, steam dynamos, condensers, &c., for the engine house, overhead travelling crane, switchboard, accumulators, mains, arc and incandescent lamps, meters, &c. Consulting engineer, Mr. Robert Hammond. See our "Official Notices," November 19th.

Dundee.—December 20th. The Gas Commissioners are inviting tenders for a supply of service fuse boxes for the electricity undertaking. Electrical engineer, Mr. W. H. Tittensor. See our "Official Notices" December 10th.

France.—December 23rd. Tenders are being invited by the French Post and Telegraph authorities in Paris for the supply, in five lots, of 90 kilometres of paper-insulated electric cables. Tenders to the Sous-Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle 103, Paris.

Gloucester.—January 18th. The Electricity Committee want tenders for boilers, dynamos, overhead crane, switchboard, accumulators, mains, arc lamps, meters, &c., for electric lighting. Consulting engineer, Mr. Robert Hammond. See our "Official Notices" December 10th.

Hammersmith.—December 22nd. The Vestry wants tenders for the supply and erection of 2 375-H.P. slow speed vertical engines, and 2 300-kw. fly-wheel alternators coupled direct to the engines. See our "Official Notices" December 10th.

Italy.—December 30th. Tenders are being invited by the Municipal Authorities of Catanzara, for the construction of a tramway between the centre of the town and the railway station, to be operated either by electricity, steam or cable.

Leicester.—January 31st. The Leicester Corporation invites designs and tender for motor vehicles for the collection of house refuse. Specifications and particulars, with drawings, to be sent to the Chairman of the Sanitary Committee, to the office of Mr. E. Geo. Mawbey, C.E., borough engineer, Town Hall, Leicester.

Roumania.—December 31st. Tenders are being invited by the General Direction of the Roumanian Posts and Telegraphs in Bucharest for the supply of 25 tons of galvanised steel wire for telephone purposes.

Southampton.—January 1st. Tenders are being invited from local firms for the electric wiring and fitting of the electricity supply station, Back-of-the-Walls, Southampton. Engineers, Messrs. Kincaid, Waller and Manville.

Spain.—December 27th. The Municipal Authorities of Utrera (Seville province) are inviting tenders for the concession for the electric lighting of the town and surrounding district during a period of five years. Tenders to be sent to El Secretario del Ayuntamiento de Utrera (Seville).

Singapore.—December 31st. The Municipal Commissioners are inviting tenders for the lighting of street lamps for a period of five years. Particulars from Mr. C. C. Lindsay, 167, St. Vincent Street, Glasgow, or the secretary to the Municipal Council.

Spain.—December 21st. The municipal authorities of Reus (Tarragona Province) are inviting tenders for the concession for the electric lighting of the town. Tenders to be sent to El Secretario, del Ayuntamienti de Reus (Tarragona).

St. Pancras. — December 28th. The Vestry wants tenders for the supply and erection of "arc lamp posts and circuits complete," also feeding and distributing mains. Particulars from the chief clerk to the electricity department. See our "Official Notices" December 3rd.

Worthing.—The Electric Light Committee want offers from persons willing to instal and maintain the electric light in the borough. See our "Official Notices" December 3rd.

CLOSED.

Richmond.—The tender of Mr. C. A. Hemingway has been accepted by the Works Committee of the Richmond Main Sewerage Board for electric lighting at a cost of £80 5s. 2d.

Shoreditch.—The Vestry has given the contract to the Electric Construction Company for three Belliss steam engines and the dynamos of 250 kilowatt capacity, at a cost of £7,640. It is understood, in connection with the coal question for the refuse destructor, that 100 tons of coal is to be kept in stock in case of refuse not being obtainable on account of snow storms. 30 tons of refuse per day is being taken from St Lukes, and it was stated by Mr. Kershaw the other day "that for the last fortnight they had not burned a pennyworth of coal."

FORTHCOMING EVENTS.

1897.

Friday, December 17th, at 8 p.m.—Institution of Electrical Engineers. (By kind permission of the Chemical Society, at their rooms, Burlington House, W.) Ordinary general meeting. Continuation of discussion on Mr. Epstein's paper on "Accumulator Traction on Rails and Ordinary Roads."

The Institution of Civil Engineers, at 8 p.m. Students' meeting. Papers to be read:—"The Elastic Properties of Steel Wire." By Mr. Archer D. Keigwin, Stud.Inst.C.E. "The Elasticity of Portland Cement." By Mr. W. L. Brown, B.Sc., Stud.Inst.C.E.

Monday, December 20th.—Last day for the receipt of tenders for electric lighting plant and apparatus for the Canterbury Corporation and the Dundee Gas Commissioners.

Tuesday, December 21st.—Brazilian Submarine Telegraph Company. Interim dividend payable.

The Institution of Civil Engineers, at 8 p.m. Paper by W. E. Dalby, M.A., &c., on "A New Transmission Dynamometer."

Wednesday, December 22nd. Tenders for the supply of engines and alternators for the Hampstead Vestry have to be lodged by to-day.

Northern Society of Electrical Engineers, at 8 p.m. Special general meeting at Palatine Hotel, Manchester, for the purpose of adopting new rules and regulations.

Tuesday, December 28th.—The Royal Institution. The first of a series of six Christmas lectures (juvenile) on "The Principles of the Electric Telegraph," by Dr. Lodge, F.R.S.

NOTES.

Insanitary Condition of the Harrogate Electricity Works.—From different quarters have come alarming allegations as to the insanitary condition of the Corporation Electricity Works. Our information, which has received ample corroboration, is that owing to the pollution of the drinking water, typhoid fever broke out some weeks ago, and unless we have been misinformed, it has been followed, in at least one case, with fatal results. The electricity works adjoin, if they are not actually built on, a sewage farm, and it seems to be generally admitted that the supply of drinking water passes through earthenware pipes which have been laid in the soil, the state of which would readily permit the water becoming contaminated. No doubt the Corporation have by this time taken steps to remedy the defective water supply; but bearing in mind the many projected schemes of dust destructors and electricity works, it behoves municipalities in general to profit by the experience at Harrogate, and take elaborate precautions for safeguarding the health of the electrical staff.

Electricity Direct from Heat.—Mr. H. B. Cox, in a lecture before the "Electric Potentials" of Boston, states that a 1 H.P. capacity thermopile of his make would furnish sufficient energy for 10 16-C.P. lamps at a cost of only 1 cent per hour. Taking the lamps as only requiring 25 watts each (a very low figure), this means 250 watts for one hour or energy at the rate of 2d. per B.T. unit. From exhaustive tests made about two years ago on a nominal 6-watt gas operated machine of the same type, it was found that the minimum possible cost per unit in London for gas and cooling water was 33½d. using ordinary coal gas and water from the public supply. Of course the 1 H.P. machine, whose performance is quoted above, was on a much larger scale, and no doubt fired by coke or other solid fuel, but even then it seems questionable if the cost could be so largely reduced, and in the absence of further proof the statement can hardly be accepted.

"Electric Organ."—With further reference to the note on this subject, which appeared in our last issue, we understand that in the organ referred to small wires insulated with a single covering of paraffined cotton were put on to terminals which consisted of common joiner's screws and copper washers set closely in a piece of lead-painted pine, the current in passing from one terminal to another had converted a large portion of the surface of the wood into charcoal. Large numbers of these wires were passed in bunches under iron staples, and in many places the wires were joined by being loosely twisted together without any soldering or other efficient means of connection, the joints being left uncovered. Electric current was obtained from a dynamo and secondary cells, and, we believe, the authorities of the church expressed surprise that the instrument did not work properly, seeing that it was comparatively recently constructed, and had since once or twice been rebuilt by an eminent London organ building firm, under the wing of a titled metropolitan organist. Obviously, if organ builders do not seek the assistance of skilled electrical men, they will bring electrical organ work into disrepute.

Electrical Engineer Wanted for Shanghai.—The Council of the Foreign Community of Shanghai require a chief municipal electrical engineer at £460 per annum. For particulars as to general conditions, qualifications, &c., see our "Official Notices." Applications have to be lodged in London by January 15th next.

Comparative Economy of Direct-connected and Belt-driven Generators.—Very recently the *Railroad Gazette* endeavoured to obtain from some street railway managers and from engine builders information concerning the relative economy between direct-connected and belt-driven generators in electric railroad work, but these inquiries met with no favourable response, inasmuch as accurate tests had not been made. Now, however, says the *Western Electrician*, such a test has been made at the power house of the Chester Traction Company, Chester, Pa. A tandem compound condensing engine, built by Robert Wetherill & Co., with cylinders 20 and 36 inches by 48 inches, and designed to run at 100 revolutions a minute, was direct-connected to an eight-pole 400-kilowatt multipolar General Electric generator, running at 100 revolutions. The engine was supplied with steam from four horizontal return tubular boilers, burning a fair quality of Likens Valley buckwheat coal, free from moisture. The results of the test, which lasted 17 hours 30 minutes, showed that the coal consumed in pounds per kilowatt-hour was 3·004, and the coal in pounds per engine horse-power was 2·242. This test was followed by one on two condensing engines with cylinders 22 by 48 inches, and running at 80 revolutions. These engines were also built by the same company as those used in the other test, and were supplied with steam from the same source as the compound engine. Coal from the same source was used in both cases. The boiler pressure was 100 lbs. A Westinghouse compound railroad generator of 225 kilowatts was belted to each engine. The results of this test showed that the coal in pounds per kilowatt-hour was 3·882. The feed water per engine horse-power was 2·901. A comparison of the two results showed a saving in coal of 22·7 per cent. in favour of the tandem compound, and while this saving would have been less had there been one instead of two generators in the latter case, yet the results show unmistakably the economy of direct-connected units. Besides this, J. D. Rostron, civil engineer of the Chester Traction Company, points out that the difference of the interest on the cost of installation would be comparatively small, and would reduce the foregoing figure but about 7½ per cent. Referring to the tests, Mr. Rostron writes as follows: "I have made other tests upon the same pair of engines, and the results show an economy of 20·6 and 21·3 per cent. I wish to note, however, from close observations, I find compounding or railroad work is productive of good results, providing the proper method of valve setting is adopted. I arrived at the present stage of economy after changing the relation of cut-off in the two cylinders three times on the present compound engine. One point to avoid is receiver expansion, which is a great loss."

Lectures.—Before the Mason's College Engineering Society at Birmingham on 9th inst., Mr. R. H. Housman read a paper on "Transmission of Electric Power." The lecturer gave some interesting figures, showing the cost of electric power as governed by the load factor and capital outlay. He also compared the various items in the cost of production of current in factories with the cost in the case of a typical central supply station, his conclusion being that electric power can be produced much more cheaply in the former case than in the latter. He showed how the efficiency of a motor varies with the load, and how much more economical it is at light load than a steam engine. The lecturer further urged the advantage of fairly large motors, each driving a shop, over small ones driving one machine. A discussion followed on the economy of electric transmission as compared with belts or ropes.

At the Glasgow University Engineering Society on 10th inst., Mr. H. A. Mavor lectured on "Recent Applications of Electrical Engineering."

Before the Doncaster Scientific Society on 24th ult., Mr. T. Cuttriss lectured on "Electricity in Vacuo."

Dr. Fleming lectured last week at the Crouch End Social Union on "Electric Discoveries during the Queen's Reign."

Mr. Richard Kerr, F.G.S., lectured at the Music Hall, Aberdeen, on 9th inst., on "Wireless Telegraphy."

Fixing Leather to Metal.—The *Scientific American* quotes from a German paper the following directions to be followed in order to fix leather to metal:—"Digest one part (weight) coarsely crushed gall nuts with eight parts (weight) of distilled water about six hours and filter through linen. Then pour one part (weight) of cold water over one part (weight) glue, leave it standing for 24 hours and heat the whole, whereby a concentrated glue solution is obtained. Now coat the leather with the warm gall nut extract, bring the glue solution on the roughened and warmed metal, lay the leather on it, press it firmly, and allow to dry in the air. The leather will adhere so firmly to the metal that it cannot be separated without tearing it."

Lubricants for the Prevention of Sparking.—In a recent article in this journal describing an "Emery Wheel Machine for Commutators," the writer referred to attempts which had been made to reduce or prevent sparking at the brushes by reason of flats on the commutator. The writer added that the application of various mixtures of lubricants and conducting agents, as a rule, only give temporary relief, and the application of emery paper or a smooth file soon becomes necessary. We have now received from the Kingfisher Patent Lubrication Company, of Leeds, a lengthy communication on this subject, and they hint that the writer of the above-mentioned article was unacquainted with the properties of their anti-friction compound, which they claim prevents all wear, friction, or sparking, and is a good conductor of heat and electricity. The inventor of this "Emissary" lubricant is stated to have made the following among other tests:—He has accurately measured the commutator of a large dynamo before and after a 12 months' run of 10 to 12 hours per day, during which period the brushes were neither trimmed nor removed. At the end of that time it was impossible to detect any appreciable wear in either commutator or brushes, and no grooves or ridges could be detected under or between the latter. The prevention of actual contact of the metallic surfaces by the interposition between them of a very thin film of the Emissary compound, was responsible for this result. Our correspondents then proceed to claim various qualities for their compound which have already been notified in these columns, and they compare their lubricant with that supplied by other firms.

The Paris Exhibition of 1900.—The Hungarian Government, under the auspices of his Excellency M. Bela de Lukacs, is making extensive preparations for participating on a large scale in the forthcoming Paris Exhibition. At a recent meeting held at the Buda Pest Chamber of Commerce, M. de Lukacs stated that in the Machinery and Electricity Sections Hungary will make an important display, which will in no respects be behind that of other countries, and is expected to surprise the world at the great progress made by Hungary in this direction.

Waterproof and Fireproof Wood.—In order to render wood waterproof and fireproof, the following "silicification" process is made use of according to the *Gewerbe*, and is quoted in the *Scientific American*. The small boards are first laid into a waterglass solution of 5° to 10° Bé., where they are left 10 to 12 hours, when they are taken out and allowed to drip off. After drying, they are placed in a solution (gravity 2° to 3° Bé.) of calcium chloride, magnesium chloride and ammonium chloride. In this they are left four to six hours, and after dripping off and drying again, they are ready for use.

Appointment Vacant.—The Trinidad Government want an electrical engineer. See our "Official Notices" for particulars.

Laws of Induction Poetically Expressed.—The *Electrical World* prints the following from an old copy of *Blackwood's Magazine*, on the laws of induced currents :—

Around the magnet, Faraday,
Is sure that Volta's lightnings play;
But how to draw them from the wire.
He took a lesson from the heart;
'Tis when we meet, 'tis when we part,
Breaks forth the electric fire.

Electro-deposition of Gold.—We understand that Mr. Charles Butters, the managing director of the Rand Central Ore Reduction Company, who for several years has worked the Siemens & Halske process, has bought Mr. Andreoli's Transvaal patents for the electro-deposition of gold, and has asked for a six months' option for the American patents.

CITY NOTES.

The Rand Central Electric Works, Limited.

The meeting of this company was held on Tuesday at Winchester House, Sir C. Rivers Wilson presiding.

The Chairman said the company had been in existence something over 2½ years, and he thought the shareholders might now reasonably expect to know what results had been obtained by the expenditure and the labour which had been bestowed upon the undertaking. The salient features of the engagements between the company and the contractors were that it was contemplated that the works should be completed within 18 months from May 5th, 1895—that was to say, on November 5th, 1896; but, as he explained to them at the last meeting, they had under the powers conferred upon them extended that period to November 20th. After the fulfilment of the contract had been certified by their engineer, they entered upon what was called a period of maintenance which was to last three years, during which the works were to be maintained at the cost of the company by the contractors, and then during that period of three years ran also another period—a period of guarantee during which the minimum dividend was guaranteed by the contractors, and following that period of maintenance came another period of five years during which the contractors would act as their consulting engineers. It became evident from reports which reached them that it would not be possible for the contractors to complete their work by that date. They must take into consideration the enormous difficulty and the complexity of the work, which, in many of its features, was of a very novel character. At the very outset of the enterprise he (the chairman) thought the contractors had shown some amount of boldness in undertaking to finish the works in so comparatively short a period, and they therefore thought that no blame could be attached to them if they failed to complete them within the specified time; consequently they thought that every forbearance should be shown them. Under the contract it was within the competency of the directors to impose a penalty of £500 a week upon the contractors, which might run for a year, so long as the works were not completed. But in the interests of the company the board did not consider it advisable to enforce that clause; but they had come to an agreement with the contractors, under which the period of completion was to be taken as from January 1st, 1897, instead of November 20th, 1896, the contractors undertaking that from that date their guarantee of interest and dividend should begin to run. The works had now been completed, but as from the first of last year the shareholders were in receipt of guaranteed interest at the rate of 6 per cent. per annum. Coming to the question of the work which had been done, and which was in prospective, they might remember that the nature of the work which they contracted to perform was of two characters. It was mainly in connection with supplying motive power to mines, but they had also entered into arrangements for supplying lighting power. They had entered into negotiations to supply lighting power to two stations on the Netherlands Railway, and also for a portion of Johannesburg township, and he might tell them that they had entered into contracts which would absorb the total horse-power they were in a position to supply. On October 15th last the engineer gave his certificate to the effect that the works had been completed to his entire satisfaction as from July 1st last. Work, however, had been in operation ever since the early part of May, but only partially. At the present time, the whole of their apparatus was in full work. They would not be surprised to learn that the working of the undertaking had not been without certain incidents not altogether of an agreeable character. There had been occasional stoppages and interference with their lines, and they were subject to certain outrages at the hands of malignant persons. He was glad, however, to say that since they had issued notices of £100 reward for the detection of the offenders the outrages had ceased. There had also been a few accidents at the works, but, fortunately, not of a very grave nature. He thought they might very fairly congratulate themselves that the undertaking had been accomplished with so few cessations of work and so few stoppages. Their relations with the Government had been of the most satisfactory character, which was a matter of the very greatest importance in that country. They had made a very satisfactory arrangement with President Kruger, personally, for an extra supply of water from his own dam, on very satisfactory terms for the company. He did not wish to be too optimistic, but he did see for the company in the future possibilities of great extension and development. In the early part of next year they would issue a complete balance-sheet up to December 31st, but as he had told them, the dividend was secured, and would be payable early next year.

Mr. George Zwilgmeyer seconded the motion, and the report was adopted.

Bournemouth and Poole Electricity Supply Company.—The prospectus of this company, which has a nominal capital of £150,000 in 7,500 4½ per cent. £10 preference, and 7,500 £10 ordinary shares, has been before the public this week, and the list closed yesterday afternoon for both town and country. The Electric and General Investment Company, Limited, on behalf of the County of London and Brush Provincial Electric Lighting Company, offered for subscription 6,000 preference shares at £10 10s., and 6,000 ordinary at par. The directors have power to raise £75,000 in debentures. The object of the company is to acquire the interests of the County of London and Brush Provincial Company in the Bournemouth and District Electric Supply Company. The latter company had a capital of £50,000 in £5 ordinary shares, 5,725 of which have been issued and fully paid up. Loans were outstanding at November 25th, 1897, amounting to £63,891. The progress, expenditure, &c., of the Bournemouth Company, is detailed in the prospectus. On November 30th, 1897, the equivalent of 25,837 8-C.P. lamps were applied for, an increase of 2,634 since the beginning of 1897. It is estimated that the financial year ending December 31st, 1898, will show a profit of from £5,000 to £6,000. The directors of the company are Lord Rathmore (chairman), Messrs. F. W. Reynolds, F. E. Savory, J. A. Hosker, A. H. Sanderson, and R. Percy Sellon. The registered office is at Moorgate Court, E.C., and the secretary is Mr. H. B. Renwick.

The County of London and Brush Provincial Electric Lighting Company, Limited.—This company is making a further issue of 10,000 ordinary shares of £10 each, being balance of the authorised ordinary share capital of the company. The shares are issued at the price of £10 per £10 share. The directors have decided to allot the 10,000 shares *pro rata* to the holders of the existing 30,000 fully paid ordinary shares who were registered in the books of the company on November 29th, or to their nominees. Such shareholders consequently are entitled to subscribe for the present issue at the rate of one share for every three ordinary shares they already hold. Applications have to be lodged with the bankers not later than December 21st.

National Telephone Company.—The transfer books of the 3½ per cent. debenture stock will be closed from the 18th to 31st inst., inclusive, for the preparation of the warrants for the half-year's interest due January 1st.

Improved Electric Glow Lamp Company, Limited.—A meeting of this company was held yesterday, at Cannon Street Hotel, but our representative was refused admittance.

Electric and General Investment Company, Limited.—Warrants for the interim dividend on the ordinary shares for the half-year ended November 30th have been posted.

Smithfield Markets Electric Supply Company, Limited.—The shares offered for subscription have been considerably over-subscribed.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending December 12th, 1897, were £1,101; week ending December 13th, 1896, £1,075; increase, £26; total receipts for half-year, 1897, £22,981; corresponding period, 1896, £23,022; decrease, £41.

The Cuba Submarine Telegraph Company. The receipts for the month of August were £2,612, as compared with £3,997 in the corresponding month of last year.

The Liverpool Overhead Railway Company. The receipts for the week ending December 12th, 1897, amounted to £1,296; corresponding week last year, £1,098; increase, £198.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending December 10th, 1897, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,773.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1894.	1895.	1896.	Closing Quotation, Dec. 8th.	Closing Quotation, Dec. 15th.	Business done during week ended December 15th, 1897. Highest.	Lowest.
137,400£	African Direct Teleg., Ltd., 4 % Deb.	100	4 %	4 %	...	101 105	101 —105	...	...
25,000	Amazon Telegraph, Limited, shares...	10	...	...	...	5½ — 6½	5½ — 6½	...	...
923,960£	Anglo-American Teleg., Ltd.	Stock	£2 2s.	£2 9s.	£2 13s.	58 — 60	58 — 60	59	58½
3,038,020£	Do. do. 5 % Pref.	Stock	£4 4s	£4 18s.	£5 6s.	104½ - 105½	105 - 106	105⅝	104⅜
3,038,020£	Do. do. Defd.	Stock	...	...	...	12¼ - 12⅜	12¼ — 12⅜	12 7/16	12⅜
130,000	Brazilian Submarine Teleg., Ltd.	10	7 %	7 %	...	16 — 16½	16 — 16½xd	16½	...
75,000£	Do. do. 5 %, Debs., 2nd series, 1926	100	5 %	5 %	...	114 - 118	114 - 118	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	2½%	4 %	4 %	3 — 3½	3 — 3½	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	183 - 188	183 —188	...	...
653,586£	Do. Do. Sterling 500 year 4% Deb. Stock Red.	Stock	...	...	...	105 —107	105 —107	106⅛	105⅞
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	1½%	1½%	2 %	3/16 — 5/16	3/16 — 5/16	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	8½ - 9½	8½ - 9½	9⅜	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½ - 19½	18½ - 19½	...	...
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	4 %	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 11	10 — 11	...	...
30,000£	Do. do. 4½ % Debs. Nos. 1 to 6,000	50	4½%	4½%	4½%	103 —106 %	103 —106%	...	...
60,710	Direct United States Cable, Ltd.	20	2 %	2½%	2½%	10 - 10½	10 — 10½	10 7/16	10 3/16
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½%	6½%	6½%	17 - 17½	17 — 17½	17½	17 1/16
70,000	Do. 6 % Cum. Pref.	10	6 %	6	6%	18 - 19	18 — 19	18⅜	18½
89,900£	Do. 5 % Debs., repay. August, 1899	100	5 %	5 %	5%	101 - 104	101 —104	...	...
1,302,615£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4%	130 - 133	130 —133	131	130⅜
250,000	Eastern Extension, Australasia and China Teleg., Ltd.	10	7 %	7 %	7½	18¼ - 18⅜	18¼ - 18⅜	18 1/16	18 7/16
25,200£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	5 %	5 %	5%	100 104	100 —104	...	...
100,500£	Do. do. Bearer, 1,050—3,975 and 4,327—5,400	100	5 %	5 %	5%	101 104	101 —104	103⅜	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	4%	131 134	132 —135	...	...
51,100£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	5%	100 104	100 —104	...	...
69,200£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	5%	101 104	101 - 104	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	100	4 %	4 %	4%	103 106	103 —106	105½	104½
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4%	108 111 %	108 —111%	...	...
180,227	Globe Telegraph and Trust, Ltd.	10	4½%	4½%	4½%	11½ 12	11½ — 12	...	...
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6%	17½ 18	17½ - 18	17 1/16	17½
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅝%	10 %	10 %	25½ - 26½	25½ - 26½	26	25
160,000£	Do. do. do. 5 % Debs.	100	5 %	5 %	5%	102 —105	102 —105	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	10%	52 — 55	52 — 55	53½	52
100,000£	London Platino-Brazilian Teleg., Ltd. 6 % Debs.	100	6 %	6 %	6%	107 - 1 0	107 —110	...	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000	5	4 %	4 %	...	2 — 2½	2 — 2½	...	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5 %	5½%	5½%	6⅜ 6⅝	6⅜ - 6⅝	6⅝	6 5/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	15 17	15 - 17	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	14 - 16	14 — 16	...	...
119,234	Do. 5 % Non-cum. 3rd Pref.. 1 to 119,234	5	5 %	5 %	5 %	6 — 6½	6 — 6½	6 3/16	6
130,766	Do. do. Nos. 119,235 to 250,000, £4 paid	5	...	...	...	4⅜— 5¼	4⅜— 5¼	...	...
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	104 1 9	104 —109	106½	105½
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	½%	5 %	5 %	9/16 11/16	9/16 11/16	...	
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	4 %	107 110	107 110	...	...
11,839	Reuter's Ltd.	5	nil	5 %	5 %	7½ 8½	7½ 8½	...	...
3,381	Submarine Cables Trust	Ord	...	...	...	o 141	136 141	136	...
58,000	United River Plate Teleph., Ltd.	5	3 %	4 %	...	3⅜ 4¼	3⅜ - 4¼	...	...
146,733£	Do. do. 5 % Debs.	Stock	%	5 %	...	102 107	102 —107	...	...
15,609	West African Teleg., Ltd., 7,501 to 22,109	10	nil	4 %	nil	4½ 5½	4½ 5½	...	...
213,400£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	103 106	103 - 106	...	...
64,256	Western and Brazilian Teleg., Ltd.	10	3 %	3 %	2 %	9½ 10 xd	9⅜ 10¼	...	...
33,129	Do. do. do. 5 % Pref. Ord.	10	5 %	5 %	5 %	7¼ 7⅜xd	7¼ - 7⅜	...	...
33,129	Do. do. do Def. Ord.	10	1 %	1 %	...	2½ 3	2⅜ - 3¼	2 13/16	2⅞
382,230	Do. do. do. 4 % Deb. Stock Red.	Stock	...	...	...	106 —109	106 —109	...	...
88,321	West India and Panama Teleg., Ltd.	10	⅛%	⅛%	1 %	⅛— ¼	⅛— ¼	...	...
34,563	Do. do. do. 5 % Cum. 1st Pref.	10	5 %	5 %	5 %	7¼ 8¼	7¼ - 8¼	7 15/16	7⅞
4,669	Do. do. do. 5 % Cum. 2nd Pref.	10	5 %	5 %	5 %	5 - 7	5 — 7	...	...
80,000£	Do. do. 5 % Debs. No. 1 to 1,600	100	5 %	5 %	5 %	107 110	107 - 110	...	...
1,163,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds	$1000	7 %	7 %	7%	103 —107	105 110	109½	...
160,100£	Do. do 6 % Star. Bonds.	100	6 %	6 %	6%	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	4½%	5 %	6 %	12½— 13½	12½ - 13½	13⅜	13 3/16
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	6⅜	...
26,000	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277	5	5 %	5 %	5 %	10½ — 11	10½ — 11	...	...
60,000	Do. do. do. 4½ % Deb. Stock Red.	Stock	...	4½%	4½%	113 —116	113 —116	115½	114
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	5 %	5 %	7 %	26½ 27½	26½ - 27½	27	26 1/16
10,000	Do. do. Prov. Certs.	5	...	...	...	26 — 27	26 — 27	...	...
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	17 — 18	17 — 18	17 15/16	17½
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	131 —136	131 —136	133½	...
30,000	County of Lond. & Brush Prov. E. Ltg. Ltd., Ord. 1— 30,000	10	...	nil	nil	14½— 15½	13½ - 13⅝xd	15 1/16	13⅜
20,000	Do. do. do. 6% Pref., 40,001— 60,000	10	...	6 %	6 %	15½ — 16	15½— 16	15⅝	15½
10,000	House-to-House Elec. Light Supply, Ord., 101 to 10,100	5	...	...	...	9¼— 9⅜	9 — 10	9⅜	9½
10,000	Do. do. 7 % Cum. Pref.	5	...	...	...	11 — 11½	11 — 11½	11⅜	11⅛
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000	10	3 %	4 %	5 %	19 — 20	18½ - 19½	19 1/16	19 1/16
12,500	Do. Ord., 50,001—62,500, iss. at £2 prem.	10	...	...	...	18½— 19½	18½ - 19½	18 15/16	18⅝
220,000£	Do. 4½% first mortgage debenture stock	...	4½%	4½%	4½%	119 —123	119 — 123	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	1 %	2 %	4 %	17½ — 18½	17½ - 18½	18⅜	18½
19,980	*St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	5½%	7½%	10½%	16½— 17½	17 — 18	17⅛	17½
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	10 — 11	10 — 11	...	...
50,000	Do. do. 4 % Deb. stock Red.	Stock	...	...	...	103 —106	103 —106	...	
43,341	South London Electricity Supply, Ord., £2 paid	5	...	...	...	2⅜— 3	2½— 2⅝	2 15/16	2 13/16
79,900	Westminster Electric Supply Corp., Ord., 101 to 80,000	5	%	7 %	9 %	16 — 17	16 - 17	16⅝	16⅜

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. § Dividends paid in deferred share warrants, profits being used as capital.

‖ Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1894.	1895.	1896.	Closing Quotation Dec. 8th.	Closing Quotation, Dec. 15th.	Business done during week ended Dec. 15th, 1897. Highest.	Lowest
30,000	British Electric Traction	10	...	...	...	15 — 15½	15⅜ — 16¼	16	15½
90,000	Brush Elecl. Engng. Co., Ord., 1 to 90,000...	5	2½%	...	...	1⅞ — 2	1⅞ — 2	2	1⅞
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	3 %	...	...	2⅜ — 2⅝	2⅜ — 2⅝	2 5/16	...
125,000£	Do. do. 4½ % Perp. Deb. Stock.	Stock	4½%	...	...	107 —111	108 —112	...	...
50,000	Do. do. 4½% 2nd Deb. Stock Red. ...	Stock	...	...	...	98 —102	103 —105	...	...
19,126	Central London Railway, Ord. Shares	10	...	...	...	9½ — 10	9½ — 10	9⅝	...
143,106	Do. do. do. £6 paid	10	...	...	...	5½ — 6	5¼ — 6	5⅝	5 11/16
58,830	Do. do. Pref. half-shares £1 pd. ...	...	...	...	...	1 — 1½	1 — 1½	...	...
61,777	Do. do. Def. do. £5 pd. ...	...	...	...	...	4¼ — 4⅝	4¼ — 4⅝	...	...
630,000£	City and South London Railway	Stock	1½%	1 3/16%	1 2/16%	66 — 6[illegible]	66 — 68	67½	66½
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	*nil*	*nil*	...	2 — 2½	2 — 2½	...	...
99,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 99,261	5	5 %	5 %	5½%	2¾ — 3	2⅞ — 3¼	3 1/16	2⅞
17,139	Do. do. do. "A" Shares 01—017,139	5	5 %	5 %	5½%	4½ — 5½	4½ — 5½	5 1/16	5
110,000	Electric Construction, Ltd., 1 to 110,000	2	*nil*	5 %	6 %	2¼ — 2⅜	2¼ — 2⅜	2⅜	2⅜
16,343	Do. do. 7 % Cum. Pref., 1 to 16,343 ...	2	7 %	7 %	7 %	3⅜ — 3⅝	3⅜ — 3⅝	...	...
91,195	Elmore's Patent Cop. Depong., Ltd., 1 to 70,000	2	*nil*	...	...	⅛ — ¼	⅛ — ¼	...	...
67,275	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	...	...	⅛ — ¼	⅛ — ¼	...	...
9,600£	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	*nil*	10½%	...	9 — 11	9 — 11	...	...
12,500	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	6 %	8 %	10 %	20 — 21	20 — 21	20½	...
3,000	Do. do. do. 7% Pref.	10	7 %	7 %	7 %	18½ — 19½	18½ — 19½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	...	4½%	4½%	110 — 115	110 —115	114	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	10 %	10 %	10 %	22½ — 23½	23 — 24	23⅝	23
300,000	Do. do. do. 4 % 1st Mort. Debs	100	...	...	...	103 —107	103 —107	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	1½%	2⅜%	2⅜%	11 7/16 — 11 9/16	11½ — 11⅝	...	...
10,000	Do. do. Pref., £10 paid	10	5 %	5 %	5 %	16 — 16½	16 — 16½	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	20 %	15 %	15 %	36 — 39	36 — 39	37⅛	37
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	102 —105	2 —105	...	...
54,000£	Waterloo and City Railway, Nos. 1 to 54,000	10	...	...	...	12½ — 13	12½ — 13	12⅞	12⅝

Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 5% for 1890.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.
CROMPTON & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—6 9/16%; 1891—7 3/16% 1893—8%

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*** Birmingham Electric Supply Company, Ordinary of £5 (£4 paid), 7⅞, £5 (fully paid) 11.**

Electric Construction Corporation, 6 % Debentures, 103—105.

House-to-House Company, 4½% Debentures of £100, 108—111.

Kensington and Knightsbridge Electric Lighting Company, Limited Ordinary Shares £5 (fully paid) 15—15½; 1st Preference Cumulative 6 %, £5 (fully paid), 8¼—8⅜. Dividend, 1896, on Ordinary Shares 7 %.

London Electric Supply Corporation, £5 Ordinary, 2⅝—2⅞.

*** T. Parker, Ltd., £10 (fully paid), 12¼.**

Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 8—8½. Dividend for 1896—6 %.

* From Birmingham Share List.

Bank rate of discount 3 per cent. (October 14th, 1897).

NOTES ON RATING ELECTRIC POWER PLANTS UPON THE HEAT-UNIT STANDARD.*

BY WM. S. ALDRICH, Morgantown, W., Va.

THESE notes refer to a paper† on this subject read by the author before the Hartford meeting (May, 1897), of this society. No comparative data were given in the original paper. It was known that the Committee on Data of the National Electric Light Association had a report in preparation for the Niagara Falls Convention, June 8th, 1897. This was the fourth, and probably the last, of such valuable reports. It was deemed expedient, rather than refer to the previous reports, to await the publication of the 1897 report for the data needed in discussion of the author's paper.

The earlier reports of the above Committee on Data have been full of instructive information relating to many types of steam power electric plants. In all of the cases finally reported, their rating has been based on watt-hours per pound of coal. Over three years ago Mr. F. M. Rites, at the Montreal meeting of our society, discussed the data of the Washington Convention of the Association (1894). His remarks‡ at that time were so pertinent to the whole question of the economy of electric power plants, that it will not be amiss to quote them here :—

"It is impossible that competent engineering ability should be confined exclusively to the manufacturing industries.

"It cannot be assumed that the average intelligence of the designers and operators of electric light stations is inferior to that displayed in establishments of different character, and yet the enormous discrepancy between the actual results and those which should be realised surely deserves some attempt at explanation.

"It is but proper to note that the committee has chosen the record of a very high duty as a basis of comparison, and that the nature of the exacting service of electric light and street railway plants precludes the possibility of a close approximation to the highest economy under more favourable conditions; but these figures are entirely unexpected, and incidentally somewhat ridiculous, considering the energy with which the last per cent. of efficiency of the electric apparatus is insisted on by its users.

"Possibly some reason for such a remarkable state of things may be found in the miscellaneous engineering errors which usually follow an ignorantly wasteful policy, but these are as frequently met in other power plants. Perhaps, also, stations improperly proportioned and generally unfitted for economic competition may be found in the list, but these are far from sufficient to account for such universal failure to realise even a moderate degree of efficiency.

"There seems to be but one general explanation applicable to electric light or railway stations which can account with any degree of probability for such extravagant fuel consumption, and that is the excessive wastefulness of the steam engine under varying conditions of load."

It is proposed in the present paper (1) to discuss briefly the progress shown during the past four years in the economic performance of steam power electric plants as summarised by

* Paper read at the New York meeting (December, 1897), of the American Society of Mechanical Engineers.

† *Transactions* of the American Society of Mechanical Engineers, Vol. xviii., No. 733, "On Rating Electric Power Plants upon the Heat-Unit Standard," by William S. Aldrich.

‡ *Transactions* of the American Society of Mechanical Engineers, Vol. xv., No. 599, "A New Method of Compound Steam Distribution," by F. M. Rites.

the Committee on Data of the National Electric Light Association; (2) to show that the very low economy of such electric light and railway stations is not entirely due to uneconomical engines and variable loads; (3) to present a few notes upon a further consideration of the heat-unit rating for such plants. This treatment will have specially in view the necessity for some standard rating by means of which the design, installation, testing, and management, as well as specifications and contracts for these plants, may be reduced to a satisfactory basis for advancing this industry along engineering lines.

1.—Performance of Electric Power Plants on a Coal Basis.

From the several reports of the Committee on Data of the National Electric Light Association, Tables I. and II. have been compiled. An inspection of these will show what little progress has been made during the last four years in such installations. In fact, the expectations of the (1894) committee seem not to have been realised, in that they looked for much better values in the reports of subsequent years. It is a matter with which the mechanical engineer is most directly concerned. His work in the design and installation of even the most recent central station is open to criticism that cannot be applied to the electrical features of the same. Electrical engineers themselves acknowledge that the efficiency of the modern dynamo has practically reached the limit set by structural and economic considerations. Mr. Rites' remarks, quoted above, are singularly applicable to the conditions existing at the present day. In the light of what he has said, the following comparative data should be carefully studied by the mechanical engineer.

Table I.—Showing Results of Four Years' Progress in the Economic Performance of Steam power Electric Plants.

Year.	Convention of the National Electric Light Association at—	No. of stations reported.	Watt-hours per pound of coal.		
			Maximum.	Minimum.	Average.
1894	Washington ...	65	208	25	91·7
1895	Cleveland ...	24	262	36	128
1896	New York ...	81	237	33	108
1897	Buffalo ...	14	269 5	98·7	156

Table II.—Equipment of the Stations Given in Table I, Showing the Maximum and Minimum Economy.

Year.	Economy.	Boilers.	Engines.	Dynamos.	Daily output watt-hours.	Fuel.
1894	Maximum (208)	.....	.....	Arc, power and incandescent.	7,971,600	Coal, hard screenings.
	Minimum (25)	.....	.....	Arc and incandescent	80,670	Coal.
1895	Maximum (262)	Horizontal water tube.	Triple expansion condensing.	Direct connected.	22,967,952	½ soft coal, ½ hard screenings.
	Minimum (36)	Horizontal tubular.	High speed non-condensing.	Belted direct.	2,790,565	Bitumin. Pea.
1896	Maximum (237)	Horizontal tubular.	High speed compound condensing.	Belted direct.	3,270,392	Bitumin. Lump.
	Minimum (33)	Horizontal tubular.	High speed condensing.	Belted direct.	203,555	Anthracite buckwheat.
1897	Maximum (269 5)	Water tube.	Vertical compound condensing 4-valve.	Direct connected, incandescent.	.....	.....
	Minimum (98·7)	Horizontal tubular, and water tube.	Compound condensing. Compound condensing.	Belted to dynamo, Belted to counter-shaft.	.....	Screenings.

A comparison of the above, with some of the best results obtained in modern mill engines, has been noted by the committee as follows:—

In the 1894 report compared to the performance of the engine of the Chelsea Jute Mills, Brooklyn, N.Y., showing a coal consumption of 1·482 lbs. per indicated horse-power per hour, with the load *varying* from 495·21 to 764·96 horse-power. If such a performance were possible in the central station, it should result in over 400 watt-hours per pound of coal, on the basis of the committee's assumption of 90 per cent. for the mechanical efficiency of the engine and for the same efficiency in the dynamo.

In the 1896 report the committee called attention to the then world's record for steam economy as shown by the Chestnut Hill pumping station engine at Boston—a steam consumption of 11·22 lbs. per horse-power per hour, or an effective pump horse-power per hour on 1·34 lbs. of coal. If the efficiency of the direct-connected electric generators should compare favourably with that of the pumps of this engine, with no allowance for variation in load, anthracite coal used in the plant with the same economy of installation should produce 557 watt-hours per pound of coal.

In the 1897 report of the committee, Mr. F. R. Low, member of our society, very fully discussed the several sources of loss in the electric power plant, stating the discrepancies would be made up mainly from the following items: (1) Decreased boiler efficiency; (2) lesser normal efficiency of engine; (3) impaired conditions of engines; (4) unfavourable engine load; (5) leakage; (6) condensation; (7) auxiliaries; (8) heating. It is not our purpose to discuss this admirable report; but there is no reason why every feature of installation of an electric power plant should not be as fully considered in design and construction as in the case of the modern high-duty pumping station. In fact, it has been repeatedly pointed out that the chief differences are those due to the running conditions of electric plants, and not entirely due to sudden and wide variations of load. Messrs. A. G. Pierce and R. S. Hale report* of the performance of the Boston stations of the Edison companies: "In our test we have finally found the variation due to causes which we first thought negligible, to be more than the variation due to the change of load."

In this connection it is important to notice the results of Mr. H. A. Foster's analysis of the tests of 22 different power plants.† These included manufacturing establishments, electric light stations, pumping engines, &c. Plants above 200 horse-power show a remarkable uniformity in fixed charges; namely, interest on first cost, depreciation, taxes, and insurance. The operating expenses gradually decrease in plants from 200 to 1,000 horse-power, above which capacity the operating expenses seem to remain remarkably uniform and quite irrespective of load variations. The large electric stations supplying many smaller industries are scarcely affected by the instantaneous load changes in one or more of these particulars.

The conclusions to be drawn from all of the preceding clearly indicate that the economy of the modern high-duty pumping engine plant is due to a refinement of design and economic arrangement of the installation that has not yet been reached in the electric power plant. Anything which tends to advance the latter industry along the lines which have been so clearly marked out in the development of the former, merit the attention of those having such work in hand. It is believed that the standard heat-unit specifications and the subsequent contract trials of pumping plants upon this basis have combined to develop this industry to an unprecedented degree.

It is not, therefore, too much to expect that similar stan-

* Quoted by Mr. F. R. Low, Report of Committee on Data, National Electric Light Association, Buffalo Meeting, June 8th, 1897.

† *Transactions* of the American Institute of Electrical Engineers, Vol. xiv., "Variations in the Cost of Steam Power," by Mr. H. A. Foster. Paper presented at the Annual Convention, July 28th, 1897.

dard heat-unit specifications and contract trials of electric power plants will advance this industry also along the same engineering lines. At least the efficiencies, economies, guarantees, and contracts now being realised in pumping stations should be much more nearly approached by the modern electric power plant.

II.—Plant Economy as Related to Engine Economy and Variable Loads.

This seems to be the chief feature of Mr. Rites' explanation of the very low economy of the electric power plants reported upon up to the time of his paper previously referred to. We certainly do not wish to be misunderstood as taking issue with this explanation; but it is apparent, from a careful study of the last four years' record of the Committee on Data, that some very uneconomical engines have produced remarkable results in point of economy of operation and efficiency of installation. The best of engines may be poorly operated on the one hand, and the whole plant badly arranged on the other hand.

We enter as strong a plea as any one for the most economical engine in electric power plants; but we wish to add a further requirement, that there should be economic installation and efficient operation to produce the best all-round results in the course of a day, a month, or a year. We think these two features may possibly have produced the lowest cost of steam power yet recorded; namely, $11·55 per year of 3,070 working hours, reported by Dr. R. H. Thurston,* member of our society. The plant is at the Warren Steam Cotton Mill, Providence, R.I. The 1,950 horse-power "Allis" cross-compound condensing engine (cylinders, 32 and 68 inches by 5 feet stroke, 74 revolutions per minute), with Heine water-tube boilers, at 155 lbs. steam pressure, show an economic performance of 1·35 lbs. coal per horse-power per hour.

The question will continue to be asked: Why are not such results obtainable in electric power plants with similar units? Low cost of steam power or of electric power is not due entirely to multiple expansion engines of the greatest individual economy; for in the last noted instance, as reported by Dr. Thurston, the cross-compound condensing engine replaced a quadruple expansion engine.

Concerning the effect of variation of load upon modern electric power plant engines, it is further interesting to note that Messrs. A. G. Pierce and R. S. Hale state of the Boston Edison stations in the report previously noted:—"As a matter of fact, the steam per indicated horse-power in our two 200 units holds within 12 per cent. over a range from ¼ up to full output."

Along the same line it is to be noted that throughout quite a wide range of load variation the compound engines reported by Mr. A. K. Mansfield,† at the recent Hartford meeting, show a remarkably uniform rate of steam consumption. The question naturally arises whether such uniformity under wide variations of load is not more of a characteristic of compound engines than formerly considered by those who lay all the blame upon the steam engine for the poor showing in the economy of electric power stations.

With dynamos which electrical engineers now design and build, maintaining an efficiency over 93 per cent. from about one-third load to 20 per cent. over load, directly coupled to cross compound condensing engines (let us say) which mechanical engineers are designing and building, having a characteristic low range of steam consumption between similar limits of light load and over load, the question will naturally arise: Why cannot the two units be more economically put together, installed, and operated?

III.—Notes on Heat-unit Rating.

In the discussion which followed the presentation of the author's paper on this subject before the Hartford meeting, as well as in conference with members and other electrical and mechanical engineers since, it will appear that the following points have been brought out:—

That the heat-unit, as a basis for such ratings, is both rational and scientific. It is, however, not in consequence the most satisfactory standard for use by builders, contractors, and practical engineers dealing with this class of motive power machinery; namely, steam engines and dynamos.

That great differences of opinion exist as to the proper definition of the heat unit required for such a standard. There are at least four different heat units commonly employed.

That the present extensive and satisfactory use of the heat unit for steam pumping installations is as it should be, and is all right in that place; but this is no argument for its introduction and use in a similar manner in the rating of steam electric plants.

That the present way of stating the performance of electric power plants, however unsatisfactory, is easily understood by all parties interested. Chief of these, of course, is the capitalist; he can readily comprehend rating based on the coal bill.

That the load factor, after all, has not so much to do with the fuel economy of the plant, as such, however much the varying loads may individually affect any of the units of the installation, such as the steam engine. Therefore, in the large city and suburban steam power and electric plants now being installed, there is not the necessity for such strict adherence to economic load factors as in the case of plants with smaller units.

That the watt expresses the activity or rate of the electrical output in joules per second. In this respect it is analogous to the horse-power rating of mechanical output. Hence, the standard rating should be in kilowatt-hours per 1,000,000 B.T.U. supplied to the steam used in the whole plant.

That if the heat-unit basis is considered as the proper standard for the steam electric plant, the whole heat supplied to the plant should be as carefully determined, and in the same manner, as now in vogue for similar standard ratings and contract trials for steam-pumping plants.

That the boiler should be in evidence in all cases in which plant performance is mentioned. In the electric plant it is economy of installation that is desired quite as much as in the case of pumping plants. Why should the boiler performance be urged into consideration in the former case and not in the latter? If it is a good thing to introduce it in either case, it would seem proper to do so in both cases.

That the common rating of performance of pumping plants in foot-pounds per 1,000 lbs. steam would be amply sufficient for all purposes of rating electric plants for which the heat-unit basis is advocated. This seems particularly plausible on account of the small variation in the total heat of 1 lb. of steam for quite a wide range of pressures now used in modern electric plants. Taking the standard temperature of feed water at 212° Fahr., exactly 1,000 B.T.U. are required to raise the temperature and evaporate 1 lb. of feed water into steam at 77·3 lbs. per gauge (92 lbs. abs.). Taking this as suitable for a simple non-condensing engine, we may compare it with that of 150·3 lbs. gauge (165 lbs. abs.), in which 1,013·5 B.T.U. are required to raise the temperature from feed water (212° Fahr.) and evaporate it into steam at a given pressure. In this case, therefore, if we adopt 1,000 lbs. steam instead of the 1,000,000 B.T.U., we make an error of only 1·3 per cent. It is claimed that this is within the usual allowable errors of observation and measurements in power-plant tests, and that there is not enough difference to warrant the trouble required to obtain the performance reduced to a B.T.U. standard.

In this connection it is interesting to note the progress shown by the committee reports on data made to the National Electric Light Association. In 11 out of the 14 cases noted in the report presented at the Buffalo meeting of that association, the water per kilowatt-hour at best efficiency of the engine is noted. As the average temperature of the feed water in the best stations reported is from 208 to 212° Fahr., and the best results are shown by the compound condensing engines, we may conclude that the comparative water ratings are within about 1 per cent. of what such comparative ratings would be if based on the B.T.U. standard.

It is a question whether mechanical engineers will remain satisfied with results even within this close degree of approximation. The fact has been repeatedly pointed out by electrical engineers that their system of units is altogether unique, is thoroughly scientific (being based upon the C.G.S. system), and is the only system of engineering units univer-

* Reported by Dr. R. H. Thurston, in *Science*, October 1st, 1897.

† *Transactions* of the American Society of Mechanical Engineers, Vol. xviii., No. 727, "The Best Load for the Compound Steam Engine," by Mr. A. K. Mansfield.

sally adopted. Mistakes are said to be occasionally avoided in the sister profession of mechanical engineering by the insistence on the accurate use of terms and of units in electrical engineering. Dealers in electrical stocks and capitalists exploiting electrical enterprises generally have an appreciative insight into the meaning of volts, amperes, and kilowatts. Why should the time-honoured heat-unit be so difficult of comprehension by the same class of interested citizens?

A quarter of a century ago Maxwell wrote: "The consequences of this demand for electrical knowledge and of these experimental opportunities for acquiring it have been already very great, both in stimulating the energies of the advanced electrician and in diffusing among practical men a degree of accurate knowledge which is likely to conduce to the general scientific progress of the whole engineering profession."

THE RÖNTGEN SOCIETY.

The first ordinary general meeting of the Röntgen Society was held at the Medical Society's rooms on the 7th inst., under the presidency of Dr. Gladstone. A paper was read by Mr. A. A. C. Swinton, on "Adjustable X-Ray Tubes." The tubes described by Mr. Swinton were mostly those which he has designed himself, and which have already been fully described and illustrated in the Electrical Review, Vol. 40, pp. 630 and 760. The quality of the X-rays, issuing from these tubes can be modified by the simple expedient of moving either the anti-cathode or the cathode. The former method has the disadvantage that the point of emission is not fixed, and on the whole Mr. Swinton seems to prefer the adjustment of the cathode disc, though this method is accompanied with some loss of energy from the back of the cathode disc. Another improvement in Mr. Swinton's tubes is that the platinum anti-cathode is kept cool by being fixed in contact with a block of aluminium. It has been found that large currents must be used to get the best Röntgen effects, and, when such is the case, the platinum anti-cathode may be fused, if some artificial means of keeping it cool is not employed. Mr. Swinton suggested that it might be found worth while to devise a system of cold water circulation for the anti-cathode. The objection to the heating of the platinum is that it blackens the tube and absorbs the residual gas.

Dr. Dawson Turner has designed a tube, which is made by Griffin, in which the cathode is adjusted by an external magnet acting on a piece of iron fixed on the cathode stem inside the tube.

Mr. Swinton pointed out that experience had shown that there was no advantage in using very large cathode discs. The size should depend, to a certain extent, on the size of the induction coil used—being larger when the coil is larger. For ordinary use, discs of about $1\frac{1}{8}$-inch diameter, and $\frac{3}{4}$-inch radius of curvature were best.

For the best X-ray work, it was necessary that tubes of the best workmanship, such as those made by Watson and Cossar, should be used. The glass should be the thinnest that will stand the atmospheric pressure, and the cathode disc should be turned in a lathe.

Several interesting points were raised in the discussion on Mr. Swinton's paper. Mr. Noble wanted to know whether the phosphorescent screen or the photographic plate was the best method of detecting and measuring the quality of the rays emitted by a tube. He had found that there was no kind of correspondence between the indications obtained by the two methods. Mr. Swinton appears to agree that the photographic quality of the rays could not be determined by means of the screen. There appears to be an opening for a good X-ray photometer.

On the question being raised as to whether the coil or the influence machine was the best exciter of the X-ray tube, Mr. Wimshurst declared emphatically for the Wimshurst machine. None of the other speakers who had tried the Wimshurst machine had obtained such good results as Mr. Wimshurst, except that they had all found that the image was steadier on the phosphorescent screen than with the coil.

Mr. Swinton explained this by assuming that the electric oscillations were more rapid from the Wimshurst machine. Mr. Wimshurst said that with his machine he had sent a discharge through a tube which had ceased to act with an 18-inch coil. That there is something anomalous in the action of the Wimshurst machine is indicated by the fact that the Swinton tubes do not adjust with this machine as with the coil. It is surprising that nobody in this country appears to have tried the Holtz or the Töpler machine. They give much stronger currents than the Wimshurst machine and ought, therefore, to give shorter photographic exposures. But all influence machines are enormously behind coils in current strength. The Röntgen Society is to be congratulated on the good start it has made with serious work.

THE FIRE RISK OF ELECTRICAL POWER INSTALLATIONS.*

By A. LESTER TAYLOR.

The public supply of electrical energy for lighting and other purposes is now such an ordinary matter, that it is difficult to appreciate how very recently this wide use of the current became possible in this country.

The house-to-house public supply of electricity for lighting and power dates only from 1889, and in the few intervening years about 100 separate undertakings have got into work, with an aggregate capital expenditure of some £10,000,000, and with some 3,000,000 lamps connected up to date. All these figures continue to undergo a rapid upward change.

Side by side with this wider use of current from public mains has grown the increase of private installations with self-contained sources of current.

Commencing at a comparatively early date with the electric lighting of corn mills, bleach works, paper mills, and other manufacturing risks working day and night, or over long hours, more recently cotton and other mills, working only during short hours under the Factory Acts, are beginning to appreciate the advantage of electric lighting, and to bring it more commonly into use.

Recent as has been the growth into widely extended use of electricity for lighting purposes, the use of electricity for power purposes on a large scale is even more recent. Within the last two or three years an increase in the use of electrical power has occurred which is altogether disproportionately large as compared with any previous use of electricity for this purpose. This branch of electrical engineering, indeed, promises to shortly outstrip in importance the already large lighting branch.

There have also recently arisen many other commercially important uses of electricity, as in the electro-chemical production of bleaching powder, the electrical welding of metals, the recovery of metals from refractory ores such as that of aluminium, and the use of the high temperature of the electric arc for such purposes as the production of calcium carbide; but time will, I am afraid, not permit of my dealing thoroughly with even the single subject of electrical power installations as fire risks upon which I have been invited to address you.

The reasons for the rapid extension of the use of electrical power on a commercial scale appear to lie, apart, of course, from the familiarising effect of the general use of the current, mostly in the direction of convenience of use.

Electrical power so readily lends itself to more or less direct application to the precise spot where the application of power is desired, and is so easily rapidly applied and discontinued, that the precise cost during the actual moments of use is not by any means the only factor of commercial importance to the user in a consideration of the relative merits of electrical or of mechanical driving of machinery.

The experience of the insured in the number of cases where I have inspected these installations, seems to be uniformly favourable to the use of electric power, and very wide extension to almost all classes of risks, using power seems to be inevitable as the practical and commercial advantages become more widely known.

It is under these circumstances that a consideration of the additional fire risk which may be involved in the use of electrical power seems to be highly desirable.

A very pertinent question in this connection is, what has been the experience up to now?

Considered as electrical fire risks, power installations have some points in common with lighting installations, and they have also some very special points of their own.

It is agreed that accumulated experience shows that the fire risk incidental to the use of electricity for lighting is relatively slight, given only reasonably good work. (Let me remind you of the beforementioned figure of 3,000,000 lamp connections to street mains alone). In view of this wide experience under all sorts of conditions, the case for any peculiar hazard arising from ordinarily well fitted lighting installations is certainly "not proven," and becomes less proven as our experience grows wider. My own personal experience as an electrical engineer during the last 17 years, and especially my experience as a fire office expert commencing under your esteemed

* Read before the Manchester Insurance Institute, at their meeting on December 13th, 1897.

member, Mr. Lane, some eight years ago, tends to a decreasing appreciation of the practical fire hazard resulting from the use of a properly fitted installation.

But it is equally agreed that there *must be* proper fitting as to certain details, or fire hazard of a real and serious character arises, and the present relative immunity undoubtedly results from the application of rules by fire insurance companies, and especially by electric supply authorities.

Let me here remark that the greatest appreciation is due to the early action taken by the Phœnix Fire Office in formulating, in 1882, the first of such rules, which have been of enormous value, both to the fire offices generally and to the users of electrical energy, and which have, in their unique and practical excellence, formed the basis of all other subsequent rules both here and in America.

It is because these or similar rules have been adopted and enforced so generally by the engineers to the local authorities and to companies supplying current to the public, that not only have the installations connected to the street mains been generally of a good character, but electrical contractors have been habituated much more largely than would otherwise have occurred to the use of a superior class of stores, and this has reacted favourably upon the work done in isolated private installations. I repeat that the broad reason for this has been the enforcing of a relatively uniform demand on the part of the supply company or corporation for a given standard of work before coupling up the installations to their mains.

Conspicuous friends to the fire offices in this respect are the able gentlemen acting as city electrical engineers to such corporations as those of Liverpool, Manchester, Bradford, Nottingham, and some other towns. At the same time, the interests of these gentlemen are not specially directed to the prevention of electrical fires so much as to the continuity of a proper supply of current and to the prevention of the idiosyncrasies of any one consumer interfering with the supply to his neighbour, and it seems to me unfortunate that the fire offices generally cannot agree on a single standard of moderate excellence for each class of risks, and in their own best interests enforce it in the rating.

The President for 1896 of the Association formed by the Municipal Electrical Engineers alluded in his address to the subject of wiring regulations and fire risk, said that the proper people to formulate regulations and see them carried out are the fire offices, and that "the more thoroughly this was recognised the more likely these offices would be to fall into line and organise their staffs so as to ensure strict and general inspections."

On such a subject as the enclosing of motors, which does not help the electricity supply engineer in any way, it is not surprising to find that no mention of it is made in any of their regulations, and that the matter is left to the fire offices alone to deal with.

In all cases electrical installations have preceded rules, and rules may be taken as the embodiment of precautions which experience has shown to be necessary.

As experience accumulates so wider views become possible, and rules are varied accordingly to meet these wider views, and also to cover new and extended applications of the current.

Thus, as to dynamos and electro-motors, with their risk of not only themselves taking fire but of their throwing globules of molten copper (at an initial temperature of 2,300° Fahr.) over wide distances, Mr. Musgrave Heaphy, who has rendered so much service by his able compilation of the Phœnix Rules, stipulated in 1885 that—

"No dynamo is to be placed in any working room of any cotton mill, woollen, flax, jute, or corn mill, or in any mill or factory of a like description, or in any working room, or place, where any hazardous process is carried on, or in which any hazardous goods are stored." And he explains:—

"By working room is meant any room or place in which the raw material is undergoing any process tending to convert it into a more finished condition."

In an appendix to the same edition of the Phœnix Rules, Mr. Heaphy says:—

"In fixing the position of the dynamo, it must be remembered that several instances have already occurred of dynamos setting themselves on fire. A good deal of sparking may take place at the 'brushes,' and the 'brushes' may burn."

In the edition of 1896, after 10 more years experience, the following wording is added:—

"*Electrical Machinery.*—No motor is to be placed where there is risk; they must never be hidden away in cupboards, lofts or roofs, &c., unless permission to the contrary be given.

"Electrical motors, when in rooms such as above described, should be placed in an approved fireproof compartment, so that if the motor was on fire, the fire could not spread, and provision should be made that fine dust or 'fly,' &c., could not get to the motor. The resistance should be inside the above compartment.

"The positions in all cases must be thoroughly safe ones.

"The steam engine room or the mechanics' shop, for this purpose, would not be considered as a working room."

He also says of electrical power installations (which were not mentioned in 1885) that "they require the same safeguards that apply to electric light installations, in which the conditions of supply and the electromotive force of the current are similar."

Further, that "care must be exercised, as described in Rule 86, that the motor is placed in a thoroughly secure situation, and so arranged that, if on fire, the fire would be prevented as far as possible from spreading."

"Every circuit must have a cut-out and a switch on each pole.

"The connections to each motor should be such, that the current can be entirely disconnected by switches from both poles of the motor when the motor is not in use, one switch to be used for starting, and the other as an emergency switch." And in the Appendix he adds:—

"In fixing the position of the dynamo, it must be remembered that *many* instances have occurred of dynamos setting themselves on fire (the 'several' instances of 1885 having grown to 'many' instances in 1896). These important additions can hardly be held to indicate a lessened estimate of the fire risk involved in the use of unprotected machines of this class."

All our other fire office rules also practically prohibit the use of an open (or unenclosed) motor in situations where sparks from the "armatures" or the "brushes" may endanger stored goods or materials in process, as also do such foreign rules as the Swedish Tariff Regulations.

Some of the fire offices not using the Phœnix rules issued a separate set of rules, which, as early as 1888, said that:—

"Dynamo machines must not be placed in any room in which inflammable material is manipulated, or in which easily inflammable material is stored, or which has openings into any room in which inflammable material is manipulated, or in which any processes causing dust or flyings are carried on. They must be fixed in a dry place, free from dust, and as cool as possible."

"They must not be placed within 12 inches of any unprotected combustible material other than their seating," and that "where electro-motors are employed, the same care must be taken as with dynamos, and all their connections must be arranged in conformity with these rules. When used where inflammable material is manipulated or stored, they must be furnished with suitable incombustible coverings, and danger from sparking carefully guarded against."

Even the 1897 rules of the Institution of Electrical Engineers, which are hardly likely to unduly hamper the electrical industry, require that "motors should be so placed that no woodwork or inflammable material is within a distance of 12 inches from them measured horizontally, or within 4 feet from them measured vertically above them," thus clearly recognising the liability to overheating and firing.

In the absence, until recently, of any uniformly enforced standard of precaution on the part of the fire offices, coupled with ignorance of the risk and of the rules on the part of the insured, the use of open and unprotected motors has begun in the most clearly undesirable situations.

Experience of motors firing having necessitated recommendations of the provision of a separate compartment (or the use of a fully enclosed type of motor, such as the samples you see in this room), it surely follows that it is unwarrantedly hazardous to use an open type of motor within a working room of a cotton mill, such as recently occurred at Glasgow. In other risks, presenting varying degrees of hazard, similarly open motors were being freely used in situations where a real enforcement of the rules would have prohibited them.

Owing to the varying views on the part of surveyors, together with other not inscrutable reasons, some fire offices appeared to be undesirous of enforcing uniform precaution, so that neither the insured nor his electrical contractor knew what would be insisted upon in the mutual interests of the insured and the insurer (as they would have done in the case of a motor to be fed from street mains in respect to precautions of interest to the electric supply authorities).

When, therefore, a certain measure of precaution in the shape of a fireproof covering for hazardously situated motors was made a tariff requirement by the Fire Offices' Committee, I, as an engineer, thought that a very considerable step in the right direction had been attained, notwithstanding that in some very few instances, owing to previous laxity in the enforcement of the rules of the individual offices some inconvenience to the insured might result, and that a perhaps not very necessary covering for some few less hazardously-situated motors might be somewhat unduly enforced "to encourage the others." Some such inequality is of necessity characteristic of all broadly applied regulations.

It is somewhat unfortunate from the fire office standpoint that the commonly adopted type of motor turned out by the English makers has been a very open type (enclosed motors only being used for such purposes as mining or traction work where the external conditions necessitate a complete cover to protect the motor itself from damp and dirt).

It is this very open type of motor, with its characteristic powers of producing undesirable "pin wheel" effects, which has led to its prohibition in working rooms by the English rules.

The more commonly used type of American made motors, on the other hand, appear to be, as you will see from the samples here, very largely self-enclosed by an iron case forming part of the designed construction of the motor.

This self-enclosing having been called for by the tariff requirements is now being rapidly adopted as a type by a number of English makers, and is infinitely to be preferred to the device of adding an undesigned cover to an open motor not intended to be so covered by the makers.

In this connection I would mention that a dynamo maker, who is with others just equipping a new dynamo and motor manufactory in the north, told me that they propose from the first to make self-enclosed machines as their standard pattern, that is to say, to make the now usual open machines the exception.

Whilst to-day there may be in a small minority of cases some little difficulty in securing the covering of the old open type of motor, or some difficulty in a few other instances because the special circumstances do not, in the opinion of a surveyor, really require such protection from the motor; in the course of time all these difficulties will disappear through the common use of a self-enclosed motor in situations where a separate compartment is impracticable.

In this city, the requirements of the corporation electrical engineer has brought into use types of apparatus which did not formerly occur, but of which the practical excellence has been admitted after the first difficulty of providing a fresh type has been overcome.

With regard to the attitude taken by the trade journals on the new tariff requirements, it is significant to note that the ELECTRICAL REVIEW, in publishing the rules, made no comment—evidently not considering that any hardship needing criticism was involved—and

the *Electrician* merely remarked, in an introductory paragraph, "They do not contain any very startling new departure."

Already, in the short time during which this enclosing of the motor has been a tariff requirement, a number of makers have begun to turn out machines of this type where previously only open ones were made. In some instances the prices of these motors are only very slightly higher than those of open ones, but in others, where makers have not yet settled down to the new type, very considerably enhanced prices are asked for them. Open competition will soon bring these prices to a more reasonable level.

If it be argued that a self-enclosed motor is unsuitable in very large sizes, then the alternative of placing it in a separate compartment, where the freest ventilation is practicable, can be adopted. It is most important to note that it is only where these machines are *not* in a separate compartment that enclosing becomes necessary to protect the surroundings.

As a matter of common experience in surveying, it is most usual to find a motor in a Manchester warehouse, for instance, close coupled to a lapping machine, and with a wood box turned over it to protect the motor itself from its surroundings, not the surroundings from the motor. With the usual English open-type of motor, and with the wood floor and the wood box soaked with lubricating oil, together with the common practice of keeping oily rags or wipes within the same box for long periods together, undoubtedly a hazardous condition of things must exist in these cases.

It can only be considered as a patching of an undesirable combination that the continuance of such an arrangement with the simple addition of a fireproof lining to the box should be passed. Even the iron box covering specified for future installations in these risks cannot, in my opinion, compare with the more simple and effective device of having a motor made self-enclosed once and for all, and so suitably designed for the purpose.

As there is no systematic compilation and publication of a list of electrically-caused fires in this country, such as there is in the States, it is difficult to quote specific instances of fires originating at these machines.

Some time ago Mr. Musgrave Heaphy was favouring me by showing some of his interesting samples at his office, and he then showed me a collection of globules of copper which had in a molten state been thrown some 30 feet from a dynamo which had "fired," and he suggested my quoting this startling example, should any one wish to urge that there was "no danger" in connection with these machines.

One of our leading corporation engineers, who much prizes his motor load, and naturally objected to anything in the nature of a restriction to so important a branch of his supply business, said he could not see the necessity for the regulation relating to the enclosing of motors. On a later visit to him, he admitted that some danger existed, as he had in the interval had one of his own motors burn out with considerable sparking effect, so that he himself specified a metal covering to the exposed ends of the armature in his order for the renewal of the machine.

The opinion of the Fire Offices' Committee as to the liability of dynamos to self-fire has for a long time been clearly indicated by the extra rating where damage from such self-firing of the dynamo has to be covered.

The dynamo as a fire risk is to nearly the full extent as dangerous as a motor if unenclosed by a compartment or a case, but just as the natural habitat of the motor is as close to the driven machine as possible, so the dynamo is most usually found inside the engine room—a very different situation from the fire office standpoint to the spinning room of a cotton mill. Therefore, it is much less seldom that any trouble arises as to the wrong situation of a dynamo, but where it is hazardously placed then proper enclosing is, of course, necessary as in the case of the motor.

I have extracted a few typical instances of fires originating at these machines from the American published lists.

Switch not located within sight of motor. Motor burned out when started and fire communicated to wooden case. Motor and case destroyed.

Spark from small dynamo used in connection with an electric stop motion ignited cotton fibre on drawing frame in cotton mill.

Current left on 1 H.P. motor used for working organ bellows in a church. Fields finally burnt out.

Show window display. Commutator on small motor attachment to a revolving window fixture arced and ignited cloth trimmings.

Elevator motor burned out by continued operation. Employés left a store after using the elevator but neglected to throw the motor switch, hence the machine continued to run.

Poor adjustment of the brushes caused considerable sparking, which was noticed by people passing the outside of the building. The building was entered, and the motor found on fire. The wires leading to it were cut and the fire extinguished.

I quote these last two cases to instance the desirability of enclosing the commutator and brushes as well as the armature and field-magnet portions of the machines.

There are a number of fires reported as originating at or near motors and dynamos, of which the above form instances.

The motor and the source of current do not form a complete power installation. There are, of course, the connecting conductors, together with the starting and regulating resistances, the cut-outs, and the switches.

As to the conductors, the commonly applied rules as to the provision of sufficient sectional area to afford carrying capacity free from undue heating suffice.

The insulation upon the conductors should be of the typical high class character, which usually obtains in England for lighting purposes, especially so as high voltages are more commonly used in power installations.

The spacing apart of the terminals of disconnecting devices, such as cut-outs and switches, is also a matter of much importance, again, in view of the high voltages used, so as to prevent permanent arcing.

The proper covering of cut-outs, to prevent danger from flying and highly heated fused metal, is a simple necessity greatly emphasised within the past few months by two large losses in this district.

Then as to the resistances.

These accessories, which are somewhat fully illustrated by samples before you, form a part of each installation necessitating regulation as to construction and fixing, quite as much as motors and dynamos call for regulation.

Absolutely fireproof construction and situation, so that if heated to redness, they could not endanger their surroundings, is very essential. They have formed a fruitful source of fires, and are a very fit subject for stringently enforced regulations.

Concurrently with the recent great increase of the adoption of electrical power inside buildings for various purposes has arisen in such towns as Bristol, Dublin, Hartlepool, Walsall and elsewhere in increasing number the substitution of electrical traction for horse haulage in respect to the tramway systems.

You will notice that the most recent tariff regulations prohibit or tax the use of current for electrical power purposes where the current is obtained from dynamos or conductors of the description ordinarily associated with tramway propulsion installations, that is, having an "earth" return.

Our newspapers are already publishing sensationally worded paragraphs referring to street incidents in connection with these eminently useful electrical lines, lines which are growing in number, and are, it appears, likely soon to be used in such important cities as Manchester and Liverpool.

As American experience in this connection has been very wide, it may be useful to quote from expert insurance opinion, collected by the *Boston Standard* some time ago, as the result of inquiry respecting the necessity for prohibition or special taxing of the use within mercantile buildings of current derived from these trolley systems.

As I am afraid I may have already tired you by the length of this paper, and as I wish to have some time in which to explain to such as are interested the different samples which I have been able to collect through the kindness of the various makers, I must refer you to the journal I have named for more detailed particulars than are given in the sketchy extracts which follow:—

E. F. Cardell: "The trolley current should not in any case be allowed either for lights or power in mercantile buildings."

H. Wilderming: "The use of the trolley current (with a ground return) for light or power in any buildings, except street railway buildings, should, I think, be prohibited. If, however, this current is to be used, I believe the greatest safeguard would be to insist upon the location of the motor in a separate fireproof building outside the premises requiring light or power, and to convey the power to said premises by shaft, which for light should connect with a dynamo on the premises, it being understood that the conductors from the trolley shall neither run through nor over any building except the fireproof motor house."

Wm. L. Jones: "We do not permit electric lighting by trolley wires."

A. J. Truesdell: "Taking power or light from the trolley wire where there is no metallic circuit is too dangerous to be allowed. It is, in my judgment, unwise to permit it even for a large consideration. Safeguards, so called, may not be safeguards under all conditions liable to arise in connection with the trolley current."

H. G. Hopkinson: "Desires to emphasise every point made in Mr. Truesdell's letter" (above).

S. Y. Tupper: "Electricians tell me that the use of the trolley wire for light and power in mercantile buildings should be prohibited, or a heavy charge made therefor, and this I believe to be the correct principle which should govern rating associations in dealing with the subject."

James A. Waterworth: "The use of the trolley current for light and power in mercantile buildings is a wanton invitation to fire, perhaps conflagration. There is no charge that can measure the danger, and at present there is no known safeguard against it except not using it."

G. W. Cleveland: "Trolley wires, on account of the large amount of territory which they cover, and their relationship to the earth, lays them especially liable to static accumulation, which, jumping distances that the 500-volt current will not do, but will maintain after the path is once made, and cause serious arcing, which, on account of the current available on the line, makes this form of service a dangerous circuit to enter buildings under any form of construction."

A. E. Pinkey: "When the trolley wire is tapped and permitted to furnish light or power in buildings it is a rank incendiary, and should be prohibited, or an extra charge made."

Wall & Whittemore: "The carrying of lighting wires from trolley wires to mercantile risks should be roundly charged for, and only permitted when each risk is provided with cut-out switch and lightning arresters."

C. R. Tuttle: "I think during the past three years in the field that I supervise, the electrical hazard is chargeable with at least 20 per cent. of the fire waste," and he thinks special charges should be made.

George W. Babb, jun.: "I view the use of trolley current for light and power in mercantile buildings as dangerous and improper, and would not condone the hazard by a charge, but favour refusing certificates for such currents. I think it should be refused recognition, and the companies should refuse to grant such permits, and should cancel where current is taken from trolley wires. Out of 109 fires (in a certain list), 14 came from trolley wires."

Mr. Babb also mentions a list of 475 *electrical* fires.

Here are some extracts from the American quarterly fire reports:—

Crosses between telephone and trolley wires. A heavy storm, in

which large flakes fell and froze to the wires, caused a general wreck of telephone and telegraph wires and poles throughout the city.

110 telephones were burned out, so that they had to be replaced, several thousand subscribers were disconnected, and practically only underground wires were working to any extent.

Burn outs in the main switchboards occurred several times, but arcs were extinguished by the use of dry sand and cloths.

Several drops on auxiliary boards were also burned out.

Fire alarm telegraph service was crippled, so that connections to several engine houses was broken.

Another: We had a severe storm here on the 26th, which played havoc with overhead wires or the streets. A large number of the telephone company's new distributing poles, 90 feet in height, and 18 inches in diameter, were broken and fell, letting down wires in all directions. Together with this, nearly all overhead wires were disabled and crossed with electric light and trolley wires. The trolley railways were interrupted for several hours, 10 horses were electrocuted on the streets, hundreds of telephone, telegraph, and fire alarm signal boxes were burned out.

A third runs:—

Cross between trolley wire and telephone set fire to telephone exchange switchboard. Fuses were introduced on the telephone lines, but were not of sufficient length to prevent trolley current arcing across terminals. Loss, $1,000.

From which you will see that telephones are responsible for something besides bad language, and also involve fire risk.

In this country recently, a falling telegraph pole brought the wires in contact with a trolley wire, with the result that a number of telegraph instruments were burnt out.

Several fires occurred in Hamburg last year, caused by the switching of the tramway pressure on to the lighting network.

Reverting, again, to our tariff rules—Rule No. 11—as to the receptacles necessary for waste oil and oily waste, has special point in view of the now frequent installation of motors where no previous experience has existed of fast running machinery, and where such copious use of lubricants is thought to be necessary.

The requirement that the pulley of the motor shall be external to the case or compartment prevents the belt from being a vehicle for the carrying of fire *out* of the case, or of fluff and dirt *into* the case. On a recent survey in Liverpool, where an iron case had been provided for a motor near a saw bench, but with the pulley inside the case, the insured devised a curious arrangement of brushes to clear the belt as it passed into the case, so as to protect the motor from dust, an example of the advantage of having the pulley and belt outside the case; or, better still, of using a self-enclosed motor. With the exception of this detail, and as you will have perceived from the extracts I have read to you, the only new point in the tariff regulations as to the motor is, that it makes it a condition of normal rating that the unanimously expressed opinion in all fire office rules—dating even from 10 years ago—shall be uniformly observed in the interest alike of the insured and the insurance companies.

Finally, in Rule No. 5 a switch upon each main conductor is required, so that the whole current may be entirely disconnected in the event of fire or other emergency requiring it. One would suppose that such a switch, which has a somewhat similar duty to the main tap at a gas meter, is a matter of such elementary importance, especially where the source of supply is out of the control of the user, that it would be already universally enforced. All fire office rules have from the earliest issues required them. Many electric supply authorities require them, but some of these authorities do not.

Where they are required by the electric supply authorities, they are always to be found. In striking contrast to this, I could mention a number of towns where, notwithstanding fire office rules, because the electric supply authorities' rules do not require them, they are most commonly absent, showing how largely ineffective fire office rules are in the absence of joint action amongst the offices to enforce them.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1897.

[*Compiled expressly for this journal by* W. P. Thompson & Co., *Electrical Patent Agents, 322, High Holborn, London, W.C., to whom all inquiries should be addressed.*]

28,023. "An improvement on the ordinary 'tumbler' switch for use with the higher voltage electric current." A. Jackson. Dated November 29th.

28,024. "Improvements in electrical switches." J. H. Tucker. Dated November 29th.

28,028. "Improvements in and relating to automatic transformer switches." F. A. Wilkinson. Dated November 29th.

28,116. "An improvement in holders for electric glow lamps." H. C. Gover, C. F. Procter, and W. G. Pipkin. Dated November 29th. (*Complete.*)

28,157. "An improved form of relay." R. Hope-Jones. Dated November 30th.

28,159. "Means for use in lighting railway cars or carriages by electricity, and for regulating the current for the same." S. Watkins. (The American Railway Electric Light Company, United States.) Dated November 30th. (*Complete.*)

28,212. "Improvements in the electrolytic treatment of ores and slimes for the recovery of precious metals therefrom, and apparatus therefor." H. Riecken. Dated November 30th.

28,225. "Improvements in electric railways." W. M. Brown. Dated November 30th. (*Complete.*)

28,238. "An improved coupling for electric light fittings." W. D. G. O'Halloran. Dated November 30th.

28,242. "Improvements in or relating to negative plates for secondary batteries." P. J. R. Dujardin. Dated November 30th.

28,246. "An improvement in safety electric fuses." H. C. Gover and W. Muller. Dated November 30th. (*Complete.*)

28,254. "Improvements in electric switches." H. M. Salmony. Dated November 30th.

28,268. "Current collectors for electric railways with overhead wires." I. Tomar. Dated November 30th. (*Complete.*)

28,325. "Improved means for attaching lead covered electric cables to connection boxes." G. C. Allingham and W. Fennell. Dated December 1st.

28,338. "Improvements in pumps for exhausting electric incandescent lamps." F. J. Satchwell. Dated December 1st.

28,350. "Improvements in, and relating to, dynamos and electric motors." J. E. Liardet. Dated December 1st.

28,351. "Improvements in, and relating to, electric lamps for cycles." C. Heap and T. Oddy. Dated December 1st.

28,362. "Improvements in the method of, and means for, transmitting electric currents in railway and tramway systems." E. M. Grant. Dated December 1st.

28,382. "Improvements in and relating to commutator brush carriers for electric machines." H. H. Lake (Compagnie de L'Industrie Electrique, Switzerland). Dated December 1st.

28,414. "Improvements in, or relating to, electric indicator fittings." A. Ford-Lloyd and A. E. Mondey. Dated December 2nd.

28,457. "Improvements in apparatus for regulating and controlling electric motors." L. Higginbottom, J. H. Hindle and T. Mannock. Dated December 2nd.

28,458. "Improvements in and relating to electrically controlled submarine mines." P. C. F. Hoffmann. Dated December 2nd.

28,461. "Improvements in or relating to the globe carriers of arc lamps for retaining ash or loose particles." A. W. Riebel. Dated December 2nd. (*Complete.*)

28,480. "Improvements in or relating to the application of electric propulsion on railways and tramways." L. Vojacek. Dated December 2nd. (*Complete*)

28,492. "Improvements in variable electrical resistances." W. Rowbotham. Dated December 2nd.

28,519. "Improvements in electrical tumbler switches." A. Watson. Dated December 3rd.

28,689. "Methods and means for supplying electrical energy to electric furnaces, or to individual pairs of electrodes." H. Maxim and W. H. Graham. Dated December 4th.

28,716. "Improvements relating to controlling devices for electric circuits, or to apparatus for indicating when the current in an electric circuit exceeds a given limit." F. J. Anson. Dated December 4th.

28,721. "Improvements in the manufacture of electrical resistances of metal foil." H. Helberger. Dated December 4th.

28,726. "Improvements in lamp and shade holders for incandescent electric lamps." J. Booth. Dated December 4th.

28,727. "Improvements in insulating blocks connected with holders for incandescent electric lamps." J. Booth. Dated December 4th.

28,728. "Improvements in holders for incandescent electric lamps." J. Booth. Dated December 4th.

28,729. "Improvements in electrical switches." J. Booth. Dated December 4th.

28,737. "Improvements in or relating to telegraphic systems and to apparatus for use in connection therewith." S. G. Brown. Dated December 4th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., *price, post free,* 8½*d* (*in stamps*).]

1896.

15,550. "Improvements in conduit system tramways and appliances for the same." G. H. C. Hughes and T. Meacock Dated July 14th, 1896. On conduit railways and tramways such as those with rope or electric traction, the outer wheels are flangeless and the vehicle is guided by wheels running in the conduit slot.

1897.

15,495. "Improvements in contact boxes for electric railways." W. M. Brown. Dated June 29th, 1897. Relates to improvements in contact boxes for electric railways and consists of a base portion having a cavity covered by a lid, the centre being of non-magnetic material and sides of cast-iron. The cover has also a cavity forming an addition to the cavity in the base. The switch member consists of a ball floating in mercury, The ball and mercury are contained in a cup formed of two parts so that when the mercury and ball are in it may be sealed up. The bottom of the cup has a contact piece one end in contact with the mercury and the other end connected to the feeder circuit the top cup has also a contact piece. 5 claims.